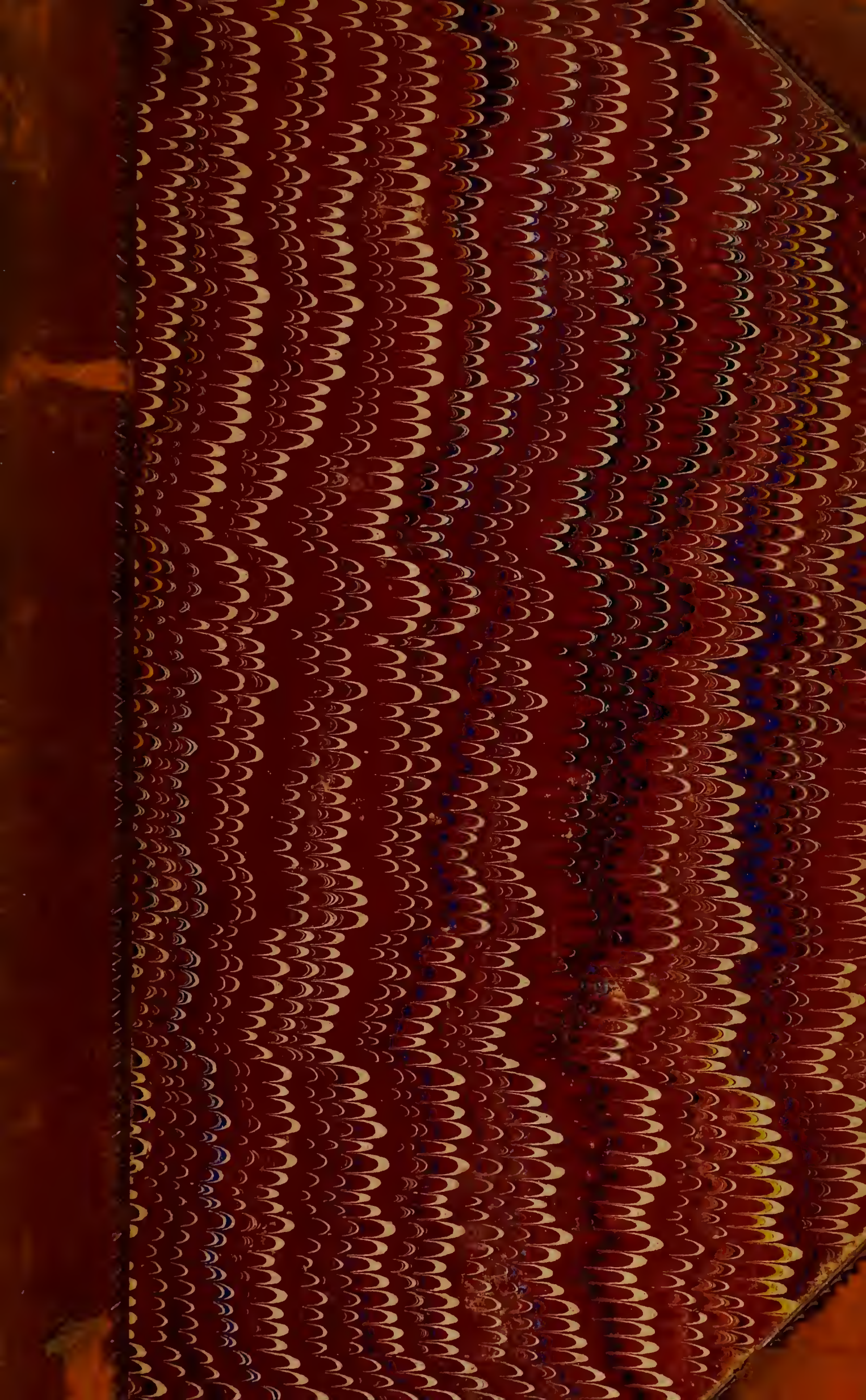






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PAPERS

ON

THE MORPHOLOGY OF THE OMOHYOID MUSCLE;
DIVISION OF THE SCAPHOID BONE OF THE CARPUS, &c.;
THICKNESS OF THE HUMAN SKULL;
DIAMETERS OF HUMAN VERTEBRÆ;
ARRANGEMENT OF PERITONEUM (ABNORMAL);
ABNORMALITY OF VERTEBRAL ARTERY;
CASE OF EPISPADIAS (WITH REMARKS);
MORPHOLOGY OF MUSCLES OF TONGUE AND PHARYNX;
AN ASTRAGALO-SCAPHOID BONE IN MAN;
ABNORMAL ARRANGEMENT OF THYROID ARTERIES;
A VARIETY OF THE MYLOPHARYNGUS, &c.;
A PALATINE BRANCH FROM THE MIDDLE MENINGEAL ARTERY;
RESPIRATORY EXCITATION AND DEPRESSION;
APNŒA AND HEAT DYSPNŒA (NOTE ON);
UEBER SECUNDÄRE WIRKUNG VOM HERZEN AUF MUSKELN;
UEBER EINIGE MUSKELANOMALIEN.

BY

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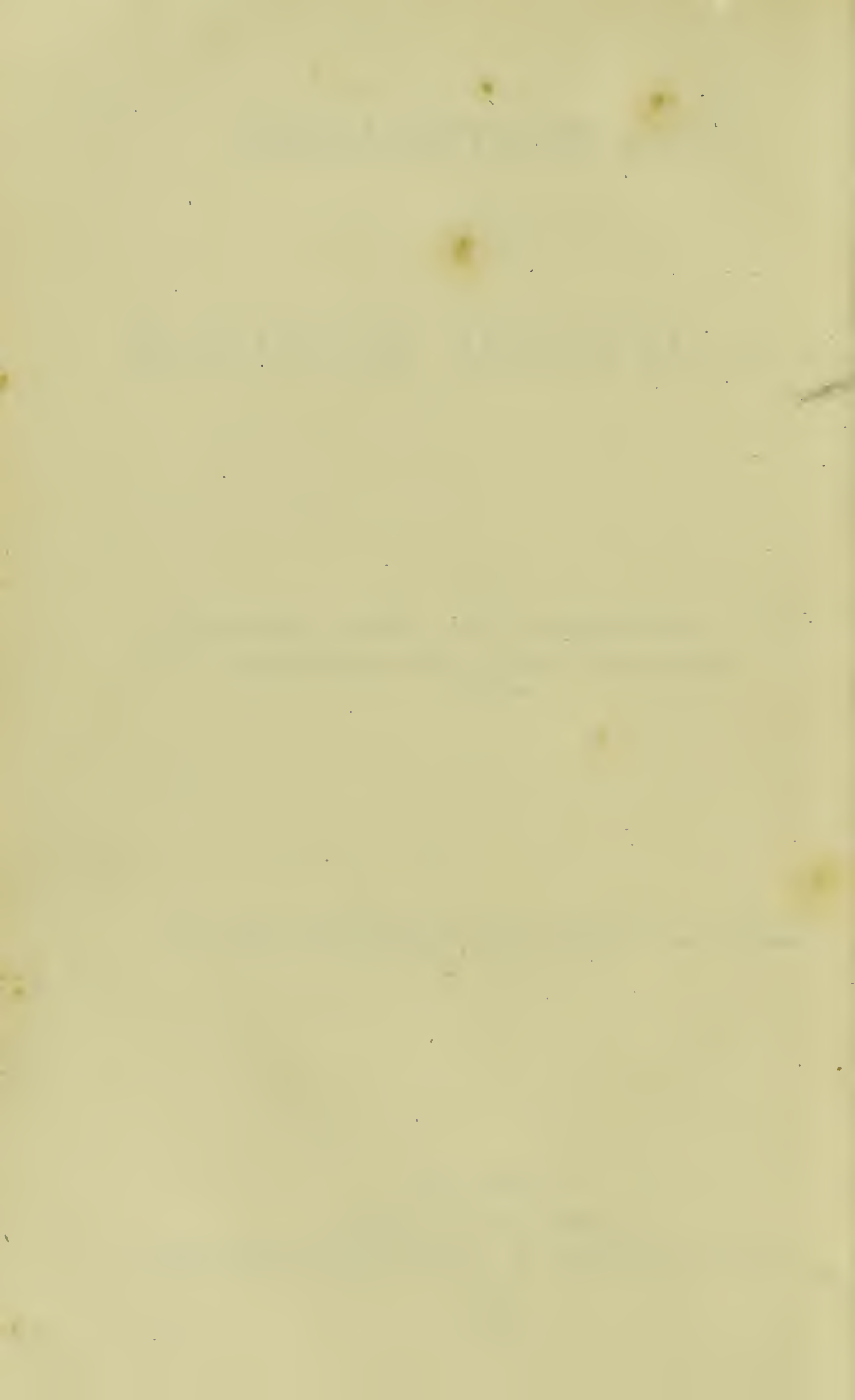
THE MORPHOLOGY
OF THE
OMOHYOID MUSCLE.

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THE MORPHOLOGY

OF THE

OMOHYOID MUSCLE.^a

THE omohyoid muscle occupies a somewhat isolated position, and, as usually seen in man and many vertebrates, attached by one extremity to the bone of the upper extremity and by the other end to the hyoid bone mediately or immediately, it has given rise to much discussion.

Professor Henle, in his handbook, states that the anterior belly of the omohyoid is a muscle analogous to the sternohyoid, the posterior to a digitation of the serratus magnus, and the tendon uniting the anterior and posterior belly has the significance of a cervical rib. As the lowest cervical rib is not developed the two muscle bellies pass into one another by means of a tendinous inscription.^b

Professor Gegenbaur from an examination of the different varieties of the muscle was led to a different result. The varieties which seem to point to the conclusion at which Henle arrived are described by Theile, Gruber, Luschka, and other anatomists. The muscle described by the first anatomist as attached to the upper border of the scapula at the place of origin of the normal omohyoid (which was absent in this case) and by its opposite extremity to the first rib has been regarded by succeeding observers as a variety of the subclavius. The instance given by Professor Gruber^c is named subclavius by him, and the cases mentioned by Luschka, Gegenbaur explains in a similar manner, and shows that these cannot be regarded as transitional forms of the omohyoid.^d

The same anatomist points out that tendinous inscriptions have not usually the significance of ribs, and adduces the examples of the biventer

^a Read before the Ulster Medical Society, Session 1880-81.

^b Handbuch d. Systemat. Anatomie. Muskellehre. P. 123. 2 Aufl.

^c Neue Anomalien. P. 19.

^d Ueber den Musc. omohyoideus und seine Schlüsselbeinverbindung. Morphologisches Handbuch. 1875. P. 243.

cervicis, complexus and rectus abdominis, where the tendinous intersections indicate simply the remains of the original separation of the muscle into a number of segments corresponding to the body metamers. The presence of a tendinous intersection at the lower extremity of the sternohyoid serves to strengthen the relation, as it shows the intimate connexion of the sternohyoid and omohyoid. The tendinous intersection of the omohyoid being generally well marked, and sometimes of considerable length, is explained by the facts that the muscle here makes a bend and it is in relation with the deep cervical vessels. The varieties met with in the animal series and in man show that the omohyoid belongs to a muscle group which is represented in man by the sternohyoid and sternothyroid. This group is supplied by the cervical nerves coursing in the hypoglossal path. Secondly, in the lower forms the origin of this muscle group extends from the sternum to the clavicle and is continued to the scapula. In crocodiles an episternohyoideus is present, which in the saurians becomes an episternocleidohyoideus, and in platydactylus (Sanders) extends to the claviculo-scapular articulation, whilst it passes quite to the scapula in uromastix (Furbinger). By separation of individual portions of this muscle, muscles arise distinguished as the sternohyoid, sternothyroid, cleidohyoid, and omohyoid—a simple absence of muscle substance giving rise to the varieties observed in man and animals. The most frequent variety is the cleidohyoid, which in man, though frequently present, is not usually developed. This variety occurs once in every 15 subjects according to Hallett.^a In 373 subjects, 8 on both sides, 4 right side only, 5 left side only, majority in middle third, rarely inner third (Turner^b). One in 12 subjects (Gegenbaur^c).

Finally, the fascia uniting the omohyoid to the clavicle is explained by the retrograde metamorphosis of the cleidohyoid. This is shown by the fact that muscular fibres are to be found in the fascia having the same character and course as those of the cleidohyoid; and the fascia is attached to the muscle, and more firmly to the tendon, with which it is intimately connected. This fascia, which extends from the lower inner border of the omohyoid to the clavicle, is not to be regarded as a portion of the deep cervical fascia.

Albrecht^d shows that although the omohyoid is part or is represented by part of a continuous muscle layer in certain vertebrates, yet in a very considerable number of animals the omohyoid is present as a distinct muscle or is absent altogether, and that it is recognisable in the lower classes.

^a Edinburgh Medical and Surgical Journal. 1849.

^b Edinburgh Medical Journal. 1861. P. 982.

^c L. c. P. 247.

^d Beitrag zur Morphologie des M. Omohyoideus.

In mammalia we find it in the lowest forms; in the ornithodelphia it is almost the same as in man. In echidna,^a according to Mivart, the omohyoid does not much deviate from the condition found in the higher mammals (man). In ornithorhyncus^b the omohyoid is present and inserted with the mylohyoid into the hyoid bone; a sternohyoid is present as a distinct muscle. In the marsupials^c the omohyoid presents a scapular origin. The omohyoid is wanting in the edentates (Owen, Humphry,^d Macalister,^e Galton^f). The ungulates have an omohyoid. In the ruminant artiodactyla the origin is somewhat variable from the transverse process of the last cervical, in the giraffe from the transverse process of the third cervical. The pachydermatous artiodactyla (Humphry^g) possess an omohyoid which passes over the anterior edge of the scapula to the upper border to be connected with the radial tubercle of the humerus and the deltoid by fibrous tissue. In the hippopotamus, according to Professor Humphry, the omohyoid passes from the side of the basihyal and the subhyoidean septum to the under surface of the occipito-humeral part of the trapezius, which it joins at an angle and is united to it by an inscription.^h In the horse,ⁱ of the perissodactyla, the omohyoid arises from the coracoid process. The omohyoid is absent in the carnivora, but some possess it, as meles, hyæna, lutra. Of the pinnipedia, Prof. Humphry^h states that this muscle in phoca^h is continuous with the sternohyoid, forming a broad muscle which is inserted into the sternum, the ulnar tubercle of the humerus, and a fascial band between the two, similar—as Albrecht remarks—to the arches of the diaphragm or the tendinous arch in connexion with the adductor magnus. In the descoid placental mammals an omohyoid similar to man has been described in tarsius and cheiromys. Rodents that have a clavicle have an omohyoid. Of the insectivora no erinaceous muscle is present. According to Professor Macalister, in the vespertilionidæ the omohyoid is slender and distinctly biventral. In the phyllostomine bats scarcely a trace of tendinous intersection. In noctulina a band arises from the middle of the clavicle and joins the sternohyoid midway between the origin and insertion; above the point of union is a tendinous intersection.^j In primates the omohyoid is similar to that muscle in man. In troglodytes aubryi an omocleidohyoid is present (Grateolet).

^a Mivart. Trans. Linnæan Soc. Vol. XXV., p. 383.

^b Owen. Anatomy of Vertebrates. Vol. III., p. 5, Fig. 3.

^c Gegenbaur. Op. cit. P. 259.

^d Journ. Anatomy. Vol. IV., p. 29.

^e Trans. Roy. Irish Academy. Vol. XXV., p. 232.

^f Trans. Linnæan Soc. 1870. P. 571. Vol. XXVI., p. 523.

^g Observations in Myology. P. 127.

^h Humphry. Op. cit. P. 126. The foremost fibres run on to the humerus.

ⁱ Owen. Anat. of Vertebrates. Vol. III.

^j Trans. Roy. Soc. Vol. CLXII. 1872. P. 134.

Albrecht^a tabulates the varieties of the omohyoid, thus:—

1. Mammals in which a muscle homologous to the omohyoid is absent—

(1) Edentates, (2) many Carnivora, (3) Pinnipedia, with the exception of phoca, (4) Rodentia without a clavicle, (5) many of the Insectivora, (6) Cheiroptera, with exception of noctulina (*see* Macalister).

2. With the omohyoid resembling closely the omohyoid of man—

(1) Ornithodelphia, (2) Didelphia, (3) Meles, hyæna, lutra (Carnivora), (3) Prosimiæ, (4) Rodentia with clavicles (5) Insectivora erinaeus, (6) Primates, with the exception of troglodytes aubryi.

3. With a musculus coracohyoideus, Equus.

4. M. cleidohyoideus, Noctulina.

5. M. omocleidohyoideus, A. Troglodytes aubryi.

6. M. omobrachio-hyoideus, Sus.

7. M. trapezio-brachio-hyoideus, Hippopotamus.

8. M. sterno-brachio-hyoideus, Phoca.

9. M. spondylo-hyoideus, Ruminantia.

Of these varieties the first five are known to occur in man, and have been recorded by anatomists; of Nos. 6 and 8 examples must be extremely rare. An example differing slightly from these forms I shall give later on. Instances have, however, been given which approach the conditions given above; thus, Hallett and Schwegel show detached bundles of the posterior belly inserted into the sixth cervical transverse process or into the sterno-mastoid and into the fascia of the scalenus (Hallett). Kelch and Grüber have mentioned a muscle which passes between the outer end of the clavicle and the transverse processes of one or several cervical vertebræ. A cervico-costo-humeralis is described by Prof. Gruber, which was inserted into the smaller tuberosity of the humerus by two tendons into the transverse process of the sixth cervical vertebræ and the anterior end of the first rib cartilage. The other varieties referred to by Prof. Gegenbaur, Albrecht gives, and remarks that the examination has been confined to the mammalian and reptilian type. These varieties are the M. episternohyoideus of crocodiles, the episternocleidohyoideus of saurians, and the episternocleido-omohyoideus superficialis of the mastix. The evidence in favour of the omohyoid belonging to the system of the rectus abdominis, amongst the mammalia, Albrecht points out, is based principally on the presence of a cleidohyoid in a noctulina, an omocleidohyoid in a troglodytes aubryi, and the musculus brachio-sternohyoides of phoca. In opposition to this the monotremes present a condition of this muscle resembling closely that of the higher forms. On the other hand, the amphibia, and not the reptilia, are to be looked

^a Albrecht. Loc. cit. P. 11.

upon as morphological allies of the mammalia. In the frog an omohyoid is known to exist, and the same muscle has been described in many other amphibia. Humphry has described the muscle in menobranch and cryptobranch. The condition in uromastix may be looked upon as a union of the omohyoid with episternocleidohyoid.

Albrecht shows that in fishes—of which he takes as examples *spinax*, *acanthias*, *raia clavata*, *acipenser sturio*, and *gadus morrhua*—interbranchial muscles belonging to the internal oblique layer of Humphry are present. Thus, in *spinax* six interbranchial muscles—the last or (sixth) being the muscle extending from the shoulder girdle to the last branchial arch (omozonio-branchialis), the latter not necessarily the morphological equivalent of one of the others—are present, united with the mesial layer or layer of the rectus (omozonio-hyoides); external interbranchial muscles, belonging to the external oblique layer, are present; in *raia* the external and internal muscles are present; in *acipenser* the former are wanting, and the sixth of the latter (omozonio-hyoides) gives evidence of separation into two muscles; in *gadus* all the external and the first two internal branchial muscles are absent, the sixth being divided into two separate muscles; in amphibia the first four interbranchial muscles present variations—they are absent in tailless batrachians; the fifth and sixth have the following arrangements:—the latter being divided into two, one or other or both being persistent. The sixth dorsal interbranchial is present in *siren*, *proteus*, and *menopoma*—absent in *menobranchus*, *cryptobranchus*, *anoura*, and others. The sixth ventral internal interbranchia, with the fifth, is united in one muscle, the omohyoid—the posterior part of which is represented by the sixth, the anterior by the fifth, interbranchial muscle—in *proteus*, *menopoma*, and *amphiuma*, where both muscles join the sternohyoid; in *cryptobranchus*, where the anterior belly joins the sternohyoid; and in the tailless batrachians, where both bellies are free.

The observations of Albrecht, as will be seen, serve to confirm those made by Humphry, as far as the continuation of the internal oblique layer forwards to the neck is concerned, and as the subject requires a reference to the views of the latter anatomist, I shall here summarise them.^a

The internal oblique stratum represented by that muscle in the abdominal wall is continued to the thorax as the external intercostals, and here the ribs are developed in this stratum as well as the sternum and the limb girdles, and is continued into the neck, where the hyoid bone is developed also in this layer. In the abdomen, the internal oblique, the quadratus lumborum, rectus, and pyramidalis; in the thorax, the external intercostals, levatores costarum, rectus thoracis, rectus thoracis lateralis sternocostalis; in the neck, the scaleni, rectus capitis lateralis,

^a Observations in Myology. P. 123.

sternohyoid, sternothyroid, hyoglossus, geniohyoglossus, and the middle and inferior constrictors of the pharynx. To the same stratum may be referred the styloglossus, the stylohyoid, the stylopharyngeus, the digastric and the superior constrictors. The muscles that pass to the shoulder girdle are those which pass above the glenoid cavity belonging to the serratus or *costo-scapular group*, which group is prolonged into the omohyoid and levator anguli scapulæ anteriorly, and those that pass to the girdle below the glenoid cavity, the costo-coracoid group, including the sterno- or costo-scapularis and the subclavius. The nerves to the limb serve to separate the groups in question.

In cryptobranch (p. 11) the internal oblique fibres acquire an antero-posterior direction near the mesial line, and are continued into the deep fibres of the rectus. Anteriorly the omohyoid has a very similar relation to the sternohyoid. If, then, we trace the middle layer forwards, we have as its representatives, attaching the limb to the trunk, the serratus and levator anguli scapulæ posteriorly, the costo-scapular or costo-coracoid (subclavius) attaching the limb to the trunk anteriorly, the nerves to the upper limb separating the anterior (lower) from the posterior (upper) group. The nerves which separate the subclavius from the serratus separate the omohyoid from the same muscle.

The omohyoid and subclavius present many important points of resemblance, and these will be more readily seen if the varieties of the latter muscle be compared with those of the former.

In *emys europæa* the subclavius arises from the under part of the first costal plate, and is inserted into the suprascapula and the contiguous part of the scapula.^a In the crocodile the epicoraco-humeral muscle, which Professor Rolleston regards as the homologue of the subclavius, arises by two heads—the inner from the visceral surface of the scapula, the outer from the precoracoid and from the prescapular portion of the preglenoid expanse. The inner is intimately connected at its insertion with the pectoralis major, and, together with the tendon of the outer head, occupies a position between the deltoid and pectoralis major. The insertion of the omohyoid corresponds with the origin of the preglenoid head, and the fibres of the two muscles are, to some extent, continuous with one another, at least in young specimens.^b In the emu, according to the same anatomist, the epicoraco-humeral muscle arises from the mesial part of the sternum or “rostrum” of the bone, from the coraco-clavicular membrane, and from an irregularly quadrangular preglenoid headland constituted by the scapula and coracoid; it is inserted into the humerus above and internal to the deltoid, and superficial to the coraco-brachialis.

In apteryx, according to Professor Owen, a portion of the pectoralis

^a Owen. *Anatomy of Vertebrates*. Vol. I.

^b Rolleston. *Trans. Linnæan Soc.* Vol. XXXV., p. 609.

minor, which he called subclavius, arises from the anterior angle of the sternum, and is inserted into the coracoid.^a

In echidna, according to Mivart,^b no pectoralis minor is present; a small muscle arises from the first rib, and is inserted into the coracoid. The subclavius of Owen is inserted into the coracoid in ornithorhynchus. This rectus is inserted into the coracoid at no great distance from the epicoraco-humeral (the homologue of the subclavius of other mammals).

In the wombat of the marsupialia the subclavius arises from the first rib, and is inserted into the outer end of the clavicle, and by means of the fascia covering the supraspinatus into the whole length of the spine of the scapula. It is joined by a fine tendon or thin muscle that arises from the sixth costal cartilage. A fascicle of the rectus abdominis passes into this muscle near its attachment to the rib.^c

In dasypus sexcinctus of the edentates the subclavius arises from the first rib, and is inserted into the whole extent of the upper border of the acromion process by a flat tendon, and becomes continuous with the fascia over the supraspinatus and the head of the humerus. It is split into two portions by the strong coraco-clavicular ligament. In orycteropus capensis the subclavius arises from the manubrium and the first rib, at its junction with the sternum, and in part by a slight prolongation of its fibres from the aponeurosis of the rectus. It is inserted aponeurotically, along the upper border of the acromial half of the clavicle, into the acromion and supraspinatus fascia.^d In chlamydophorus truncatus it arises from the first rib, and is inserted into the coracoid process, acromion, and the acromial end of the clavicle.^e In ai it is inserted into the clavicle and coracoid process.^f The subclavius is absent in manis, myrmecophaga jubata, and some others. A retro-clavicularis is present in chlamydophorus, and arises from the upper surface of the first rib, near the sternal end, and is inserted into the acromion process and supraspinatus fascia and coraco-acromial ligament.^g

In ruminants a sternoscapular muscle arises from the manubrium, and is inserted into the scapula.^c

In the hippopotamus the subclavius is expanded upon the supraspinatus at its insertion, forming a sternocosto-scapularis. In the pig it reaches the radial tubercle of the humerus.^g

In the porcupine the subclavius arises from the costal portion of the first rib, has a slight attachment to the scapular extremity of the clavicle, and is finally inserted into the spine of the scapula, the supraspinous

^a Owen. Op. cit. Vol. II., p. 609.

^b Trans. Linnæan Soc. Vol. XXV., p. 382.

^c Rolleston. Trans. Linnæan Soc. Vol. XXVI.

^d Galton. Trans. Linnæan Soc. Vol. XXVI.

^e Macalister. Trans. Roy. Irish Acad. Vol. XXV.

^f Humphry. Jour. of Anat. Vol. IV.

^g Observations on Myology.

fascia, and by this to the deltoid, and is extended over the supraspinatus to the humerus.^a

In the guinea-pig the subclavius arises from a small surface on the presternal pro-osteon, and from the cartilage of the first rib, exteriorly, to which latter point of origin the epicoracoid has coalesced with the vertebral rib. Some of its fibres are inserted into the coraco-clavicular ligament and some into the clavicle, but it receives fibres also from the clavicle. The muscle is then inserted into the acromion (anterior border), and with the deltoid some fibres become continuous.^b

In the cheiroptera the subclavius arises from the first rib, and is inserted into the clavicle.^c

The following table represents the varieties, with an origin from the first rib, rib and manubrium, and rectus, or precoracoid and scapula. It is inserted into—

- (1) The suprascapula and scapula.
- (2) The humerus.
- (3) The coracoid.
- (4) Outer end of clavicle and spine of scapula.
- (5) Acromion, supraspinatus fascia, and humerus.
- (6) The scapula, with an origin from the sternum.
- (7) Receives fibres from rectus.
- (8) Radial tubercle of humerus.
- (9) Spine of the scapula and humerus.
- (10) Coraco-clavicular ligament, clavicle, and acromion.
- (11) Clavicle only.

Comparing the varieties found in man with these, the subclavius has occasionally an attachment to the clavicle, coraco-clavicular ligament, and coracoid process. It may be inserted into the clavicle, coracoid process, and upper border of the scapula, and may at the latter place be intimately connected with the supraspinatus fascia. A condition, very similar to that of ruminants, was observed by Mr. Wood, and recorded by him many years ago. The subclavius may be absent; of this I have met with two cases in ninety subjects dissected during the present session. Absence of this muscle was observed by Prof. Gruber.

If the varieties of the omohyoid be placed side by side with those of the subclavius, it will be seen that, first, as far as the origin is concerned, there is evidence of a connexion with the rectus. In the case of the former the anterior belly is inseparably united with the ventral muscle in some lower forms, and occurs as a not infrequent variety in man, so that in these the posterior belly must be regarded as a muscle radiating from the rectus, and, in the case of the latter muscle, a variety is pre-

^a Rolleston. Loc. cit.

^b Galton. Loc. cit.

^c Macalister. Trans. Roy. Soc. 1872.

sented in the wombat, where the fibres are (in part) continuous with the rectus. An origin of the omohyoid, on the other hand, from the sternum is not, so far as I know, on record; and an example of a sternoscapular muscle, which, I think, must be regarded as belonging to the sternohyoid set of muscles, I shall give later on. The insertions of the omohyoid and subclavius present, however, many characters which show a definite relationship between these muscles. Each muscle is inserted in some of the animal forms into the clavicle, scapula, coracoid process, and humerus. What in man is a normal attachment of the omohyoid, is an aberrant attachment of the subclavius, and the omohyoid is attached to the under surface of the clavicle in a large percentage of cases. Six cases were recorded in ninety subjects during the present session (1880-81).

I shall now give some varieties of these muscles. Two of the subclavius are recorded with accompanying variation in the attachment of the omohyoid.

The first case is that of a costo-scapular muscle, differing but little from the cases of Theile and Wagner. That it was a true subclavius will be easily seen from the description.

1. In a female subject, aged forty-five, on both sides of the body a muscle arises from the cartilage of the first rib by a tendon one and a half inches in length; this is continued into a round fleshy belly which passes beneath the clavicle, to which it is attached by a firm fascia, over the subclavian and suprascapular arteries and brachial plexus, and is inserted into the upper border of the scapula for one inch, extending forwards from the superior angle. The muscle is supplied by a branch from the fifth and sixth nerves of the brachial plexus. The omohyoid arises from the under-surface of the clavicle for the extent of one inch at the junction of the middle and outer thirds of the bone; it passes upwards and inwards and unites with the sternohyoid. Below the point of union is situated a tendinous inscription in the omohyoid, from the inner extremity of which a fibrous band passes inwards to the sternohyoid, where it is prolonged into a tendinous inscription less marked than that of the omohyoid. From the arch so formed fleshy fibres pass up to the conjoined sternohyoid and omohyoid, filling up the triangular interval by a thin fleshy stratum. The fibrous band, which was one-tenth of an inch broad, has been referred to by Professor Turner in his paper.

2. The second example occurred in a male subject, aged fifty. The trapezius is inserted into the outer two-thirds of the clavicle on each side; on the right side the external jugular vein passes through a foramen in the muscle close to the clavicle, and the supraclavicular nerves pass forwards through the same foramen. The omohyoid is attached to the upper border of the scapula from the superior angle to

the notch, to the ligament over the notch, and to the base of the coracoid process; it is further attached to the outer half of the clavicle. The external jugular vein and supraclavicular nerves pass beneath a tendinous arch close to the clavicle, to which some fibres are attached. The muscle is inserted into the hyoid bone superficial to the sternohyoid. A cleidohyoid muscle arises from the inner third of the clavicle for the extent of one inch, is separate from the sternohyoid in all its extent, and is inserted into the hyoid bone above that muscle. On both sides a supraclavicularis is present, arising from the manubrium beneath the sternomastoid; it is inserted into the clavicle between an anterior and a posterior layer of the sternomastoid. The interest attaching to this case is due to the many irregularities. The individual varieties have been observed by many anatomists. The attachment of the omohyoid superficial to the sternohyoid is the fact which I shall make use of.

3. In a male subject, aged forty-eight, on the left side of the body the omohyoid has the normal origin. Above the middle of the clavicle it divides into two parts; the upper is connected with the anterior belly by means of a tendon, and this belly of the muscle is closely connected with the sternohyoid. The lower division, half an inch broad, is inserted into a more than usually strong tendinous inscription in the sternohyoid. The place of insertion is on the anterior aspect of the muscle. A muscular fasciculus is given by this muscle to the sternothyroid, the outer border of which it joins.

4. Instances are on record where the omohyoid presented a double belly at the anterior and posterior part. In a male subject (left side) this muscle arises from the scapula at the usual place, and is inserted into the hyoid bone. So far the muscle presents no unusual features, but for an extent of three inches extending on both sides of the tendinous inscription the muscle is double; each part resembles a normal omohyoid.

5. The last variety in this connexion to which I shall refer is the case of absence of the anterior belly. This variety is rare, as Professor Macalister did not meet with it once in 600 subjects. The variety occurred in a female subject, in which the omohyoid of the right side presents an anomaly somewhat similar to that recorded by M'Whinnie. A portion of the outer fibres passes over the sternohyoid near its insertion, over the hyoid bone and beneath the mylohyoid, and then enters the geniohyoid. A portion of the sternohyoid crosses beneath this bundle and is continued into the hyoglossus. On the left side of the head and neck the omohyoid arises from the scapula and terminates in a fibrous band in front of the carotid vessels. This divides into two; both pass upwards; the inner is inserted into the os hyoides, the outer is lost in the cervical fascia, with which both are in close connexion.

These varieties point to the fact that the anterior belly of the omohyoid, usually distinct in the case of man, lying side by side with

the sternohyoid near its insertion, and inserted border to border with it, and so far may be understood as obtaining its substance, not from the rectus, but from the prolongation of the lateral internal oblique layer, as distinguished from the mesial part; yet the variety given under No. 2 shows that the anterior belly may have an intimate connexion with the superficial part and not the external part. And No. 5 shows, as, indeed, other varieties, that the anterior belly may be connected with the posterior part of the prolonged rectus. Variety No. 4 is another illustration bearing on this point—a portion of the omohyoid is inserted into the anterior part of the tendinous intersection of the sternohyoid. Unless a portion of the anterior belly be considered as absent in this case, we must regard a part of the sternohyoid above the intersection as portion of the omohyoid that has coalesced with the sternohyoid, but a third assumption is possible—namely, that the fibres of continuation are to be sought in the part below the intersection. In case, then, these varieties point to the fact stated by Prof. Henle that the anterior belly corresponds to the sternohyoid, and should be regarded as the analogue, or, to go a step further, as a differentiated part of the sternohyoid mass, this differentiation can be easily accounted for. The separation of the cleidohyoid, as given in No. 2, from the more deeply placed sternohyoid, can be explained on the same principle as the separation of muscles into layers in the limbs and elsewhere, and such an interpretation is rendered almost certain by the fasciculated varieties met with in connexion with the omohyoid. The division of the muscle given above was as perfect as the ordinary separation that exists between the sternohyoid and the omohyoid; and the muscle shreds that so frequently exist between the omohyoid and the sternohyoid is additional evidence bearing on this point. On the whole, therefore, the varieties met with point to the fact that the anterior belly of the omohyoid should be regarded as a portion of the sternohyoid (at least in man), and that the tendinous intersection of the central mass represents the point at or below which the separation takes place. That the breadth of the tendon of the omohyoid to some extent depends upon the extent of the original connexion of the posterior belly with the mesial mass. Its length is probably due to a variety of circumstances—the extent and firmness of the fascia investing it, the length of the muscle, and the angle of junction. The first and last because they affect its action, and the second, conjoined with either of the former, would serve to increase its length. The absence of an anterior belly is attributable, without doubt, to a solution of the connexion with the mesial mass, or to its original weakness.^a

^a Dr. Whitla, of Belfast, has told me of a case where the anterior belly was displaced by a small round tendon on both sides. It occurred in a person who had worn a trachea cannula for forty-three years.

So far, then, as the omohyoid can be regarded as composed of a sternohyoid portion and a recto-scapular portion, the posterior belly is similar in its anterior connexions with the portion of the subclavius met with in *phascolomys* and *orycteropus*, which in these creatures is connected with the rectus or its expansion; and the similarity in the attachments of the muscles posteriorly I have already mentioned. The nervous supply of the two muscles is different, and is apparently an argument against the homology of the muscles, if there were no other; but the fact that the omohyoid is intimately connected with muscles supplied by the nerves in the tract of the *descendens noni*, and other instances, such as that of the *levator anguli scapulæ*, and the *serratus* where the nervous supply is different, at least frequently—the former muscle, no doubt, sometimes receives a branch from the fifth; but a branch from the third is a very constant nerve to this muscle—furnish reasons for this difference in nervous supply.

The *supraclavicularis*, originally described by Professor Gruber, has an attachment at the inner and outer end of the clavicle. Tendinous at each extremity and fleshy at the middle, it has been considered by the anatomist who first described it as a tensor of the fascia, and by him regarded as the representative of the fibrous band which one sees occasionally above the clavicle giving attachment to the *trapezius*. The muscle occurred twice during the present session in the anatomical rooms, and in one case corresponded exactly with the description given by Gruber. This muscle was supplied in the case to which I refer by the *descendens noni*. A muscle such as this supplied by the *descendens noni* seems to show that it does not correspond to the fibrous band situated above the clavicle, but must be regarded as a muscle of a deeper layer—namely, of the layer to which the depressors of the hyoid bone belong. It would more appropriately be referred to the fibrous band mentioned in one of the notes given above. Such a muscle, then, might be regarded as a portion of the internal oblique layer which lost its attachment to the sternohyoid band and acquired an external attachment to the clavicle at a place where a *cleidohyoid* muscle is sometimes found. That the muscle must be regarded in this light is, I think, shown by the following variety, which, as far as I know, is new:—

In a female subject, aged seventy-eight, on the left side of the head and neck the omohyoid is attached to the outer third of the clavicle for one inch, and is prolonged to the upper border of the scapula where it is attached to the ligament over the notch, as also to the bone. Arising in this way the omohyoid passes it upwards, and is inserted into the hyoid bone. A faint line which extended transversely across the muscle indicated the line of division of the muscle into two parts. The *subclavius* on this side has a slight attachment to the clavicle externally (half an inch). It is, however, attached by a slip to the coracoid process,

and by a band to the upper border to the scapula beneath the omohyoid. The arrangement resembles that of Böhmer's case, cited by Professor Macalister.

On the right side a sternoscapular muscle arises from the posterior surface of the sternum in this way:—From the anterior surface of the tendon of origin of the sternothyroid tendinous fibres are prolonged upwards and outwards. These are reinforced by fibres arising from the anterior surface of the sternothyroid, and which have a transverse direction above the tendon and below the tendinous intersection of the same muscle. From the band so formed external to the sternothyroid a muscular belly arises, which passes outwards above the clavicle over the subclavian artery and brachial plexus, and terminates in a tendon two inches and a half long, which is inserted into the upper border of the scapula and ligament over the notch for the extent of one inch. A small band passes down to the outer third of the clavicle, and a portion of the fibres is continued into the supraspinatus fascia. The breadth of the tendon of origin is one inch and a quarter; the breadth of the muscle about four lines. The omohyoid has a slight origin from the upper border of the scapula, but is attached to the upper border of the outer tendon of the sternoscapular muscle for its whole length. The muscle passes upwards and inwards to the hyoid bone, and is connected with that muscle so closely, three inches below its insertion, that it cannot be easily separated. Below the point of union a muscular fasciculus from the omohyoid joins the sternohyoid. A tendinous inscription is present above the middle of the omohyoid, oblique in direction, and very faint. The sternoscapular muscle is supplied by a branch of the descendens noni which enters the muscle near its inner tendon. The sternohyoid of the right side has only a clavicular origin, so that, in reality, it is not properly designated by this name. On the left side the muscle has both a clavicular and sternocostal attachment.

This muscle has much in common with the suprascapularis proprius and the retro-clavicularis, and I think these two muscles may be considered varieties of the foregoing. Dr. Macalister has already stated as his opinion that the muscle described by Mr. Lawson Tait is to be regarded as a variety of the suprascapularis. To the same set the sternohumeral muscle of Gruber may with justice be referred. The position of the supraclavicular nerves in this case seems at first sight to show that the sternoclavicular muscle has a significance different from the supraclavicularis, for in Prof. Gruber's example and the two instances referred to, these nerves passed beneath, whilst the same nerves passed in front of the sternoscapularis; but this objection loses its importance when we consider that the descending nerves of the cervical plexus sometimes pierce the clavicular origin of the omohyoid or even the clavicle, or may pass under a tendinous arch into which the latter

muscle is inserted.^a The supraclavicular nerves in this example passed over the omohyoid and the sternoscapular muscle. The relations of the origin to the sternothyroid and the insertion of the omohyoid, together with the fact that the muscle has the same nervous supply, show that it belongs to the lateral ventral muscle. The connexion with the posterior part of the omohyoid seems to show that these muscles are to be regarded as parts of the same lateral muscle band; and the connexion of the sternoscapularis with the sternum internally, the clavicle and scapula externally, shows that it is a serial homologue of the subclavius. The posterior belly of the omohyoid must, I think, be regarded as homologous with the subclavius. The reasons for this conclusion may be briefly stated thus:—

(1) The origin of the subclavius is closely connected with the rectus in some animals. Wombat, orycteropus. The posterior belly of the omohyoid passes into the mesial layer prolonged from the rectus, as a permanent condition in cryptobranch.

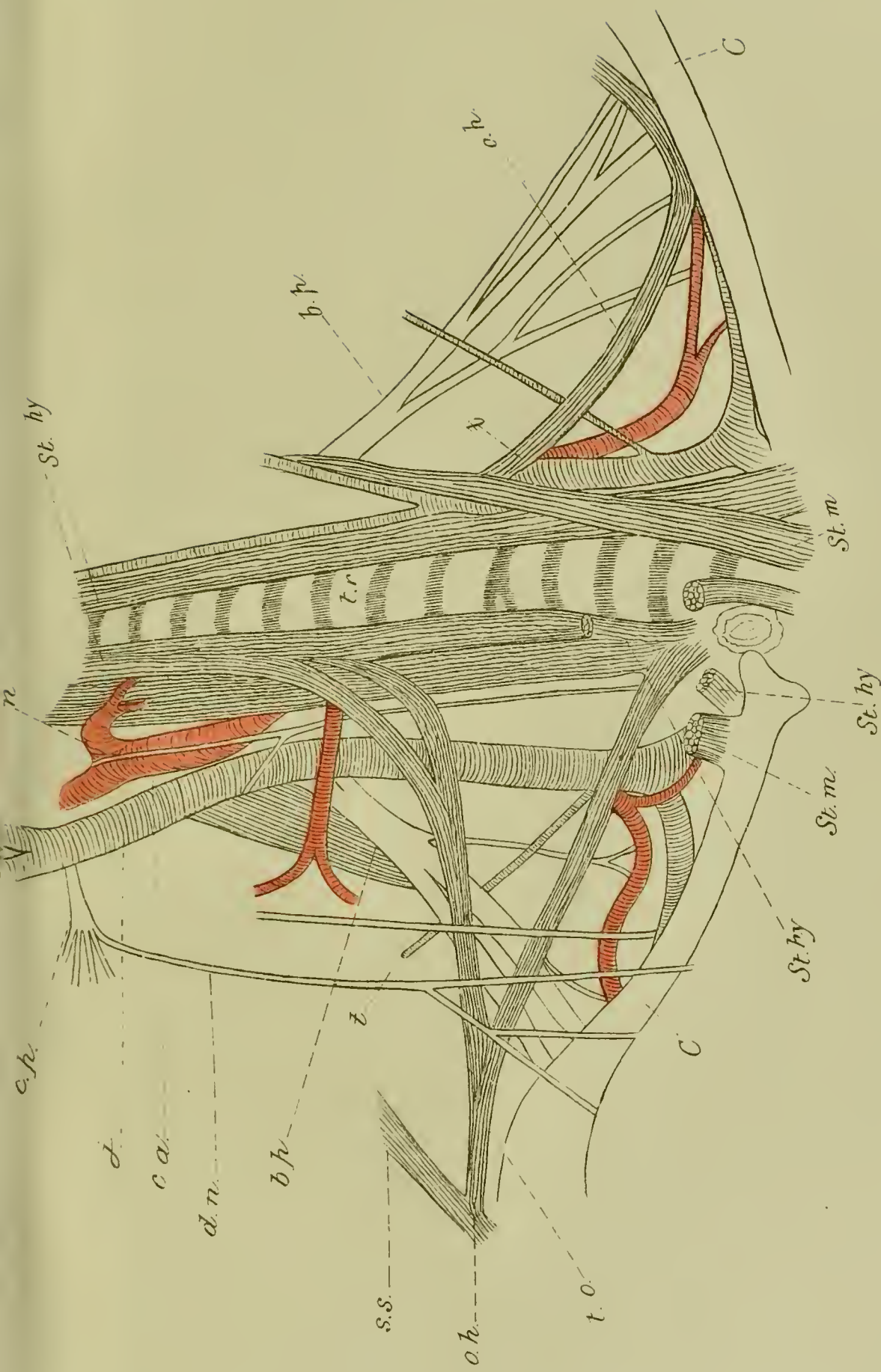
(2) The nerves of the limb separate equally the subclavius and costocoracoids equally with the omohyoid from the serratus or costo-scapular group.

(3) The aberrant supraclavicular muscles present an origin and insertion similar to the subclavius, and resemble closely the omohyoid in their attachments, relations, and nervous supply.

(4) The extensive clavicular attachment of the omohyoid in certain of the animal series can be explained as a part of the attachment of the recto-clavicular muscle—the inner surface, in some cases, being part of the rectus prolongation.

(5) The omohyoid is bound down to the clavicle so closely in many cases as to completely obliterate the subclavian triangle—in 13 out of 373 subjects (Turner, loc. cit.); and the same arrangement occurs when the subclavius takes origin from the scapula, as in case given above.

^a Krause. Die Nervenvarietäten. During the present session I have recorded three instances where a single branch of the descending nerves perforated the clavicle.



EXPLANATION OF PLATE.

c. p.	Cervical plexus.	s. s.	Supraspinatus.
j.	Jugular vein.	C.	Clavicle.
c. a.	Carotid artery.	tr.	Trachea.
d. n.	Descending branches of c. p.	st. hy.	Sterno-hyoid.
b. p.	Brachial plexus.	st. m.	Sterno-mastoid.
o. h.	Omohyoid.		
t. c.	Transverse cervical artery.		
t.	(on right) Tendinous intersection of omohyoid.		
t. o.	Outer tendon of sterno-humeral muscle.		
n.	Descendens noni.		

DIVISION OF THE SCAPHOID BONE OF THE CARPUS,
WITH NOTES ON OTHER VARIETIES OF THE CARPAL
BONES. By R. J. ANDERSON, M.A., M.D., *Demonstrator of
Anatomy, Queen's College, Belfast.*

IN a carpus of the left side of a male subject, a division of the scaphoid occurs. The other carpal bones present no unusual features.

The scaphoid consists of two parts, an anterior and a posterior portion. The posterior part is the larger, and has an upper convex surface for articulation with the radius. This surface is eburnated along the inner half of its extent, and the outer half is rough and non-articular; the whole surface measures one inch, and is rather more than a line broad. The inferior surface (outer) articulates with the trapezoid and the trapezium. The outer end is rough and non-articular; the inner end has a slight notch which receives the semilunar. The anterior surface is concave, eburnated, and has grooves from friction; it is broader externally than internally, and articulates with the anterior portion. The internal surface (for os magnum) is narrow, in part articular for the os magnum. The anterior segment is not unlike the pisiform in shape and size. It has an upper convex articular surface for the radius covered with cartilage. A lower concave articular facet which, with the scaphoid, receives the head of the os magnum. The posterior surface is convex, eburnated, and grooved, and articulates with the posterior segment. The inner end articulates with the semilunar.

The abnormal character of the carpus above described resembles those mentioned by Gruber in his various papers, and in position the os centrale of the typical carpus. Professor Gruber points out in one of his papers¹ that a small notch is present in $\frac{2}{3}$ ths of all the scaphoids, below the ulnar end of its dorsal surface. The notch is generally semilunar, of variable size and depth. This notch is sometimes large, and may receive a ninth carpal bone, which there lies between the trapezoid, the scaphoid, and the os magnum. Professor Gruber brings forward good reasons for believing this to be the representative of the central bone of the carpus. Amongst other English anatomists Professor Struthers found a bone in the situation mentioned by Gruber, and described it in the *Journal of Anatomy and Physiology*.² This anatomist considers it to be a fracture with formation of a false

¹ Reichert and Du Bois Reymond's *Archiv.*, 1873, p. 716.

² Nov. 1873, p. 113.

joint. In Virchow's *Archiv*,¹ Professor Gruber discusses the question, and points out that, apart from the presence of the small bones in the situations above mentioned, there is nothing that indicates any abnormality due to disease or injury, and states his conclusions thus :—

- (1.) Fractur des Naviculare Carpi geht immer in sagittaler, d. i. in der die Längsaxe des Knochens kreuzenden Richtung und fast an derselben Stelle vor sich.
- (2.) Totale Fractur bestehe immer ohne Dislocation der fragmente.
- (3.) Gelenkknorpel und Articulationen seien selbst bei totaler Fractur so wenig in Mitleidenschaft gezogen, dass Zeichen davon ersteren in späterer Zeit an der Leiche nicht mehr nachzuweisen sein.

Now, in the above-mentioned case, we have evidence of pressure not only between the pieces of the scaphoid (the scaphoid and centrale), but further evidence of pressure and friction at the upper surface of the posterior bone. Whilst in the lower piece the posterior surface is eburnated and worn a groove by the rubbing, whilst the radial surface is covered with normal cartilage. If this example be regarded as a case of the scaphoid and centrale being present, then it remains to explain the cause of the eburnation in two distinct places, whilst all the other parts are free. On the other hand, if it be regarded as an actual fracture, it must then be concluded that fracture of the scaphoid may take place in a direction *parallel* to its longitudinal axis.

Union of the Os Magnum and Trapezoid.

The bones of the carpus of a right upper extremity present generally no unusual features. The os magnum, however, which has its inner surface normal, and an upper part or head of the usual size and shape, has the piece of bone representing the trapezoid attached to its external surface. Posteriorly the surface of the os magnum is continuous into that of the trapezoid without intermission, but a slight very superficial groove seems to indicate the line of original separation. The upper surface of the trapezoid shows the usual quadrilateral facet, and it is continued into the os magnum without any line marking a division. The inferior surface of the bones is articular for the second metatarsal and third ; posteriorly there is no line of separation, but a fissure exists at the anterior part, which occupies the lower and anterior surfaces.

This condition seems to be rare, and the fact that no other carpal bones are involved, leads to the hypothesis that the union took place at a very early period, or that the bones never became completely differentiated. To find the scaphoid and semilunar united, we must look down low in the mammalian series. In certain of the Ruminantia, viz., in Pecora and Tragulina, the trapezoid and os magnum are confluent. In the three-toed sloth the same condition obtains.²

¹ Vol. 69, 1877, p. 391.

² Flower, *Osteology of Mammalia*.

Coalescence of the Semilunar and Cuneiform.

The specimen which I have represents a case of perfect union of the semilunar and cuneiform. The upper surface of the former passes into that of the latter without any interruption, and the large convex quadrilateral facet would seem to limit the extent of the former bone. The anterior faces of the bones are continuous, as also the posterior. The bones can be best limited on the inferior surface. From without inwards first comes an antero-posterior concave facet, then a linear facet for the unciform separated from the former by a ridge, then a groove succeeded by a double curved surface. This condition approaches that of the carpus of *Pteropus*, when the bones of the first row are united. Wagner met with a case similar to that described.¹

OBSERVATIONS

ON THE

THICKNESS OF THE HUMAN SKULL.

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OBSERVATIONS

ON THE

THICKNESS OF THE HUMAN SKULL.

THE variation in the thickness of the human skull in different individuals, and in different parts of the same skull, is well known. The causes of these varieties have been assigned to the character of the soft parts, the changing character of the brain, and are, in a great measure, due to the same causes that regulate the growth and development of the individual.

The following observations were in 154 skulls of subjects brought to the anatomical rooms. The measurements were made with callipers carefully adjusted, and in the following regions:—

- A. The superior angle of the frontal in the superior longitudinal sinus.
- B. Above the external angular process.
- C. Parietal eminence.
- D. The anterior superior angle of the parietal outside the longitudinal sinus and the Pacchionian depressions.
- E. The posterior superior angle of the parietal.
- F. Posterior inferior angle of the parietal in the lateral sinus.
- G. In the middle fossa, near the centre of the squamous part of the temporal bone.
- H. Occipital (superior angle) in the longitudinal sinus.
- I. Occipital at the middle of the inferior fossæ.
- J. Occipital protuberance.
- K. Occipital superior fossæ.
- L. Frontal eminence.
- M. Weight of brain.

Where two measurements are given, connected by a hyphen, the first indicates the size of the right, the second that of the left.

The numbers indicate sixty-fourths of an inch. Thus, in No. 1, the thickness of the frontal near the superior angle is $\frac{1}{6}\frac{6}{4} = \frac{1}{4}$ inch.

The column immediately succeeding M contains the nature of the convolution markings. These are usually best marked at the base. For the greater number they were slight or absent at the roof.

a. Convolution markings slight.

β. No convolution markings.

γ. Convolution markings distinct over lower parietal part.

In a few cases casts of the interior of the skull were made to determine how far the convolution markings would indicate the position of the fissures. From a study of these it was seen that the convolutions of the temporo-sphenoidal lobe and the lower surface of the frontal were repeated in their cast, but the upper surface of the cast was nearly smooth in many cases.

The mean of the observations in each case is given. It will be seen that although in many cases the thickness on one side exceeds slightly that of the other, yet the mean of one side does not differ materially from that of the other. The thickest skull was that of a female, aged 78, No. 144; but the three succeeding were males. The thinnest skulls in the above list were those of three females. These remarks, however, do not apply to all the measurements. And it must be remembered that the number of female subjects was in excess of the number of the males. A single measurement is not an indication of the general thickness, for in No. 84 the inferior occipital fossæ have a very thin bony wall.

The weight of the brain does not seem to bear any relation to the thickness of the skull. This, however, does not affect the statement that the skull thickens when the brain diminishes.

TABLE.

No.	Sex	Age	A	B	C	D	E	F	G	H	I	J	K	L	M	-
1	M.	—	16	—	19-18	13-11	20-18	—	—	—	—	—	—	—	—	—
2	—	—	18	—	22-23	16-15	10-10	—	—	—	—	—	—	—	—	—
3	—	—	16	—	19·5-20·5	20-16	14-15	—	—	—	—	—	—	—	—	—
4	—	—	11	—	12-12	14-10	13-17	—	—	—	—	—	—	—	—	—
5	—	—	18	—	14-13	15-14	20-16	—	—	26	—	—	—	—	—	—
6	—	—	17	—	9-8	14-15	16-15	—	—	—	—	—	—	—	—	—
7	—	—	11·2	—	16-13	6-11	12-14	—	—	14	—	—	—	—	—	—
8	—	—	17	—	-11·9	12-14	14-15	—	—	19	—	—	—	—	—	—
9	—	—	19	—	17-18	18-17	22·5-20	—	—	26	—	—	—	—	—	—
10	—	—	21	—	18·5-19·5	18-15	22·5-25	—	—	24	—	—	—	—	—	—
11	—	—	13	—	12-4	12 12·3	17-17	—	—	23	—	—	—	—	—	—
12	—	—	14	—	3-4	8-10	9-7	—	—	15	—	—	—	—	—	—
13	—	—	21	—	18-13	18-16	20-17	—	—	25	—	—	—	—	—	—
14	—	—	17·6	—	18-18	16-14	20-20	—	—	30	—	—	—	—	—	—
15	—	—	18	—	13-19	15-16	20-24	—	—	27	—	—	—	—	—	—
16	—	—	22	—	16-17	17-16	16-13	—	—	19	—	—	—	—	—	—
17	—	—	20	—	15-15	17-18	15-13	—	—	20	—	—	—	—	—	—

TABLE—continued.

No.	Sex	Age	A	B	C	D	E	F	G	H	I	J	K	L	M	—
18	M.	56	24	18-16	12-12	16-19	—	14-18	4-3	—	3-4	34	—	—	—	—
19	F.	30	22	—28	—22	22-26	—	12-11	9-14	21	3-1	29	—	—	—	—
20	F.	39	20	20-18	24-20	17-19	—	16-14	5-7	—	11-7	48	—	—	—	—
21	F.	56	16	16-14	16-20	10-7	—	14-12	4-5	—	4-4	28	—	—	—	—
22	F.	56	15	12-10	16-5	10-9	14-16	9-10	5-5·4	15	3-3	27	—	—	—	—
23	F.	60	19	12-11	15-16	14-10	16-16	12-16	4-4	18	7-6	32	—	—	—	—
24	F.	75	20	11-8	18-21	9-14	16-16	12-13	4-3	17	3-4	23	—	—	—	γ
25	M.	30	17	—	17-15	14-15	18-18	14-17	6-5	26	11-8	36	—	—	—	γ
26	—	—	18	—	13-14	15-17	9-13	10-9	—	14	6-8	38	—	—	—	γ
27	F.	60	16	—	8-11	11-12	14-13	10-13	4-3	13	7-6	24	—	—	—	γ
28	—	—	20	6-6	12-10	20-17	12-17	16-14	4-4	—	5-5	34	—	—	—	γ
29	F.	57	16	14-13	12-14	11-10	14-17	10-14	4-5	16	5-5	35	—	—	33	γ
30	M.	52	17	11-10	16-16	16-16	18-14	12-12	6-5	20	8-7	25	—	—	45½	γ
31	M.	70	13	8-10	13-12	12-14	14-13	15-14	7-6	15	4-5½	41	—	—	44	γ
32	F.	64	22	16-13	22-20	19-17	27-29	23-25	5-6	22	6-5	25	—	—	43	γ
33	M.	76	18	12-8	7-8	15-19	18-11	15-	5-2	12	2-3	35	—	—	50	β
34	M.	45	10	15-15	10-12	12-11	13-10	8-8	5-4	13	3-3	32	—	—	52	γ
35	M.	72	18	17-9	15-14	14·5-16	15-14	10-12	4½-2	14	7-4	41	—	—	56	γ

38	F.	44	20	6-6	18-15	16-16	17-14	11-11	1-3	16	4 4	28	—	—	46½	α
39	F.	70	20	23-20	15-14	20-21	12-13	12-18	4-6	20	7-6	41	—	—	—	γ
40	M.	48	13	12-14	13-16	16-13	17-20	17-16	4-2	22	8-8	40	—	—	52	γ
41	M.	68	13	—	10-12	11-9	11-11	14-18	4-2	15	14-13	37	—	—	50	γ
42	F.	30	12	12-16	16-16	10-10	16-14	12-12	4-3	11	5 3	34	—	—	41	β
43	M.	70	16	5-9	18-16	13-12	12-10	8-10	3-1	9	4-2	24	—	—	52	γ
44	M.	60	17	14-16	22-17	13-17	19-20	19-16	4-3	23	8-8	42	—	—	53	γ
45	F.	35	16	9-8	12-12	11-13	13-12	6-9	1-1	14	2-1	24	—	—	45	γ
46	F.	73	19	16-14	16-18	18-14	17-15	16-16	-2	20	4 6	36	—	—	49	β
^a 47	M.	51	19	16-16	12-16	20-18	14-12	13-16	2½-1	13	7-7	40	—	—	42	β
48	M.	70	16	8-12	16-18	14-14	14-14	14-12	6-5	17	4-3	32	—	—	53	β
49	M.	50	16	14-12	13-15	12-11	12-12	8-14	3-1	12	8-5	32	6-8	—	51	γ
^b 50	M.	13	11	8-7	12-14	9-8	15-13	7-8	1-3	14	2-2	22	7-8	—	39	γ
51	M.	63	18	16-12	17-15	15-16	18-18	17-20	4-4	21	5-6	45	15-13	—	53	β
52	F.	80	15	12-12	16-16	13-12	13-12	13-14	4-5	18	3-4	12	10-10	22-20	41	β
53	F.	35	15	12-10	16-18	16-12	17-16	12-16	4-3	23	8-8	36	10-9	16-17	45	β
54	M.	74	19	10-9	20-20	17-17	13-13	23-20	4-5	19	4-5	48	9-8	11-12	45	α
^c 55	M.	80	18	12-25	17-17	14-12	17-14	14-14	4-3	20	4-4	40	9-8	17-18	53	β

^a Lateral sinus not grooved so far as petrous portion of temporal.

^b Inner table at parts necrosed.

^c Frontal sinuses very large; two inches from side to side; ¼ inch deep.

TABLE—continued.

No.	Sex	Age	A	B	C	D	E	F	G	H	I	J	K	L	M	—
56	F.	50	20	12-10	20-19	16-16	16-16	20-17	2-1	18	4-3	25	13-10	17-	53	β
57	M.	13	12	7-8	10-10	10-10	14-14	8-18	8-8	20	8-8	27	19-11	10-8	43	α
58	M.	53	17	14-14	14-14	16-15	17-14	14-11	7-5	23	5-12	33	10-8	17-17	49	β
59	F.	60	17	17-18	21-19	14-14	21-20	11-10	11-9	27	10-12	36	16-16	15-13	42	β
60	M.	54	15	8-11	16-17	9-12	14-15	10-10	2-8	28	5-3·5	27	19-14	10-11	54	α
61	F.	55	12	10-10	14-13	14-13	14-13	11-11	1-1½	17	1-2	27	12-14	15-15	44	β
62	F.	50	15	12-10	14-14	10-12	13-16	11-9	4-4	19	4-4	37	12-24	16-14	43	α
63	M.	57	22	19-20	25-23	16-16	18-18	17-28	12-12	25	14-14	60	18-16	19-24	42	β
64	F.	55	15	12-10	13-12	14-14	16-18	13-16	3-2	23	7-6	46	10-11	12-11	51	β
65	F.	60	14	8-8	22-21	14-13	20-21	11-12	3-4	15	4-4	24	16-18	15-14	39	β
66	F.	61	15	10-9	12-12	13-12	11-13	14-19	5-3	20	4-5	30	12-12	17-16	39	β
67	F.	75	23	12-12	16-19	20-18	17-18	8-8	4-4	24	2-3	33	11-16	13-16	40	γ
68	F.	76	13	13-16	14-15	11-11	14-14	22-19	5-4	15	6-5	31	10-12	17-17	41	α
69	F.	16	10	7-8	10-4	8-9	10-9	8-6	2-3	14	3-4	28	8-8	10-7	42	γ
70	F.	50	14	8-7	13-13	10-8	16-12	11-8	1-11	18	3-2	21	10-8	13-14	43	β
71	F.	61	18	19-13	25-20	15-15	20-21	14-16	3-4	20	6-8	26	15-16	16-16	44	β
72	F.	46	16	9-9	13-13	14½-13½	16-17	10-13	2-3	20	8-9	46	11-12	16-16	45	γ
73	F.	45	17	5-11	16-19	19-18	18-19	14-16	4-4	20	6-4	37	10-9	20-19	46	γ
74	F.	53	23	10-10	10-17	14-10	14-10	11-11	2-7	22	5-7	28	10-12	14-10	47	γ

76	F.	60	16	21-13	17-18	14-13	16-18	8-14	3-1	19	7-6	28	12-10	9-10	49	α
77	F.	40	12	12-12	18-16	11-6	12-13	14-15	2-3	18	4-2	31	8-9	18-18	—	u
78	F.	38	19	13-14	11-13	12-13	14-14	13-14	3-4	25	11-11	41	8-6	19-20	—	β
79	M.	56	19	—	7-8	12-12	13-12	14-	2-	20	7-6	38	12-10	9-9	—	α
80	F.	40	12	11-10	14-10	11-12	12-12	6-7	2-2	13	1-2	25	6-8	16-16	—	α
81	M.	36	19	19-19	18-20	18-18	19-18	15-14	1-3	24	4-4	43	10-11	21-23	—	β
82	F.	38	20	8-12	18-18	15-16	19-19	12-12	2-2	31	1-2	57	19-20	19-22	—	α
83	M.	50	16	16-15	13-15	12-12	16-15	7-9	1-1	18	6-5	38	9-8	15-12	—	α
84	F.	19	12	11-13	12-13	10-9	13-14	7-7	1-1 $\frac{1}{2}$	10	1- $\frac{1}{2}$	33	6-4	11-13	—	γ
85	F.	20	12	17-12	15-14	12-11	15-15	12-10	8-6	20	4-2	34	12-11	16-16	—	γ
86	F.	70	14	7-10	15-12	14-12	12-12	8-10	3-4	18	1-2	35	7-5	12-10	—	γ
87	F.	68	16	16-15	18-19	15-14	16-15	9-8	1- $\frac{1}{2}$ -1	18	1- $\frac{1}{2}$	28	8-10	15-14	—	β
88	F.	55	16	9-12	10-11	16-15	17-17	9-18	1- $\frac{1}{2}$ -1	23	7-7	40	5-11	15-16	—	β
89	F.	65	15	16-16	12-13	14-12	9-10	10-10	4-5	14	4-4	26	8-8	16-14	—	α
90	M.	25	15	6-16	15-15	14-10	16-18	12-20	2-3	22	1-2	39	9-8	18-18	—	α
91	F.	27	10	6-6	15-14	11-8	14-14	8-8	3-3	19	6-6	40	—	10-12	—	β
^b 92	M.	71	15	16-16	13-12	13-14	12-12	16-16	2-2	14	1-6	33	9-10	8-10	—	α
93	M.	55	14	9-5	13-12	12-11	13-13	7-11	3-3	18	4-2	40	6-2	12-13	—	α
94	F.	80	17	2-8	12-14	19-12	10-9	5-12	1-1	20	3-3	33	9-7	10-16	—	β

^a Irregularity of frontal.

^b Cerebellar fossæ large.

TABLE—continued.

No.	Sex	Age	A	B	C	D	E	F	G	H	I	J	K	L	M	—
95	F.	55	12	13-16	9-11	14-10	19-19	15-13	2-2	17	4-3	28	9-10	16-14	—	γ
96	M.	75	12	12-8	8-8	12-12	10-10	8-12	1-½	16	4-3	31	4-6	8-9	—	γ
97	F.	40	20	10-11	14-16	13-13	17-17	11-10	1-2	20	5-4	34	24-16	16-17	—	α
98	M.	45	20	14-14	16-16	14-13	14-13	9-8	2-3	18	10-10	32	6-10	16-17	—	β
99	M.	60	17	24-25	22-21	18-16	18-20	14-15	4-5	28	3-2	45	9-10	32-31	—	β
100	M.	45	18	12-12	17-17	15-16	14-14	11-11	4-4	22	1-2	38	10-9	17-16	—	α
101	M.	30	22	11-11	16-16	15-13	14-14	4-6	2-2	21	3-3	29	4-5	14-14	—	α
102	F.	48	18	10-8	19-20	14-13	16-17	9-13	3-4	24	4-3	40	12-10	15-18	—	β
103	M.	60	24	10-12	19-18	28-24	20-24	17-19	3-2	28	3-6	46	16-16	20-20	—	α
104	M.	50	21	12-10	8-10	14-20	10-9	10-6	2-2	13	4-3	34	5-6	9-9	—	γ
105	M.	61	12	12-12	12-13	11-12	11-12	12-12	2-2	16	3-3	48	8-9	12-14	—	β
106	F.	61	14	16-17	22-21	18-20	16-13	12-11	4-4	24	3-3	36	8-6	24-22	—	α
^a 107	F.	61	23	16-17	18-20	18-16	25-21	12-13	4-8	32	4-2	45	24-24	20-22	—	α
108	F.	50	18	12-10	16-18	16-12	13-13	12-12	3-4	32	3½-4	40	16-15	14-18	—	β
109	F.	50	15	12-12	12-13	9-8	11-12	12-14	6-6	23	4-4	36	9-8	16-18	—	α
110	M.	48	22	22-24	17-20	22-18	15-14	12-12	3-4	16	12-13	52	15-15	16-16	—	α
111	F.	40	22	16-15	20-10	15-17	15-15	13-14	3-2	15	4-3	40	14-12	18-17	—	α
112	F.	60	20	17-18	18-20	19-19	18-18	7-12	2-3	23	3-3	40	14-12	18-20	—	β
										16	4-4	34	11-9	12-12	—	α

115	F.	46	16	12-14	18-13	12-12	16-13	16-14	2-2	20	2-4	32	9-8	13-13	—	α
116	F.	49	16	12-10	15-15	13-12	16-16	11-14	4-4	22	4-5	29	12-11	16-15	—	α
117	F.	40	9	9-7	16-16	9-9	11-10	13-8	2-1	17	5-4	28	9-8	15-15	—	α
118	F.	48	20	11-11	16-14	15-13	14-15	14-10	2-1	18	2-1	28	11-11	10-10	—	β
119	F.	70	16	13-12	12-13	15-15	14-14	8-13	2-2	17	—	40	9-8	14-12	—	α
120	F.	45	6	11-11	15-16	15-15	12-12	8-8	1½-1	16	—	34	6-5	16-18	—	α
121	M.	72	13	15-17	14-14	14-13	14-13	16-16	2-2	17	—	42	4-6	16-17	—	α
^c 122	F	67	20	14-13	3-6	14-14	14-15	9-11	1-2	21	—	31	9-8	16-16	—	γ
^d 123	F.	50	18	8-8	14-16	16-15	18-16	9-16	1-1	21	—	32	7-8	11-12	—	β
124	F.	54	18	15-20	16-20	16-15	14-12	6-7	½-2	24	—	36	11-10	24-25	—	α
125	M.	40	20	16-14	14-16	20-15	17-16	12-13	2-4	18	—	48	10-11	12-13	—	α
126	M.	70	17	13-13	10-14	16-11	15-15	19-19	4-3	17	—	48	11-13	11-13	—	α
127	F.	68	21	15-14	18-17	16-15	19-21	12-12	3-3	28	—	36	12-15	16-17	—	α
128	F.	70	18	9-10	13-16	13-12	15-13	10-11	2-2	18	—	39	8-8	10-12	—	α
129	M.	65	17	12-12	13-15	13-12	16-17	18-16	3-4	25	—	41	12-12	16-18	—	β
130	M.	69	24	17-18	25-26	19-16	24-24	19-22	2-4	32	—	55	15-14	21-23	—	α
131	F.	60	14	9-9	10-12	14-14	12-12	9-10	5-6	16	—	32	12-11	16-17	—	β

^a Frontal sinuses extend high up into bone.

^b A large depression at internal occipital protuberance, with foramen in the centre.

^c The outer occipital protuberance higher up than the inner.

^d Six Wormean bones in upper left, 7 in upper right suture; superior longitudinal sinus continuous with right lateral large frontal sinus.

TABLE—continued.

No.	Sex	Age	A	B	C	D	E	F	G	H	I	J	K	L	M	—
132	M.	40	22	14-15	8-12	14-14	18-16	16-17	6-6	27	4-2	52	13-9	12-18	—	γ
^a 133	M.	40	15	15-15	16-18	12-13	15-15	11-12	4-5	20	4-4	38	5-9	14-21	—	β
134	F.	30	12	12-10	12-16	9-10	16-14	4-4	1-1	16	3-3	34	12-10	15-17	—	α
135	M.	28	16	20-18	16-15	15-14	18-16	13-17	4-4	20	2-2	32	11-12	15-16	—	α
^b 136	F.	32	12	17-18	12-14	11-12	14-14	12-9	1-1	18	4-4	28	9-8	12-13	—	α
137	F.	45	20	14-9	14-16	13-13	16-15	14-14	2-	22	4-4	31	8-8	19-16	—	α
138	M.	42	16	16-12	6-8	12-10	8-17	9-12	2-1	16	4-2	28	6-4	11-12	—	α
139	M.	65	15	10-10	10-10	14-14	13-14	14-11	2-1	19	2-2	37	12-10	12-13	—	α
^c 140	F.	40	20	15-12	12-14	20-20	13-12	9-11	2-3	17	4-4	36	8-10	10-12	—	γ
^d 141	M.	75	18	10-12	12-14	20-18	16-15	11-13	1-2	20	2-2	28	8-9	13-11	—	α
142	F.	78	15	10-10	12-12	20-16	15-15	16-8	1-1	21	1-1½	40	10-10	14-12	—	α
143	F.	75	16	9-12	12-12	10-12	11-10	6-9	2-2	18	3-1	30	9-7	15-14	—	α
144	F.	78	26	21-20	26-28	21-23	24-28	18-14	4-4	28	4-4	40	16-16	24-27	—	α
145	M.	60	16	16-17	12-11	12-11	14-15	14-14	4-4	24	6-6	50	11-10	13-15	—	α
^e 146	M.	70	15	18-19	12-12	16-13	13-15	10-6	2-3	24	1-1	22	7-12	19-15	—	α
^f 147	M.	40	20	4-8	11-11	12-13	12-12	13-16	1-4	20	3-2	34	8-8	13-13	—	γ
148	M.	74	20	10-11	12-17	14-14	12-14	18-18	3-2	19	4-2	44	10-9	11-11	—	α
149	M.	70	20	10-9	8-10	13-14	17-18	13-18	3-4	23	2-2	37	10-10	8-10	—	α

150	F.	70	16	5-8	20-12	14-15	16-16	11-10	1-1	32	1-2	38	12-13	11-10	—	α
151	M.	65	19	13-16	14-17	13-13	11-16	12-14	10-7	18	6-6	58	12-13	18-18	—	α
152	M.	70	20	11-14	16-17	17-17	14-16	14-9	4-5	23	1-1	26	8-8	12-11	—	—
153	M.	68	18	8-8	8-11	10-13	12-16	18-16	4-3	25	5-6	50	13-13	15-14	—	—
154	F.	84	20	14-13	9-10	13-13	20-18	15-16	1-3	19	2-3	44	16-13	14-16	—	—

SUMMARY.

Age	A	B	C	D	E	F	G	H	I	J	K	L	M
	2598·8	1642-1675	2224-2307·9	2218-2126·8	2298,5-2283	1664-1772	437-431·9	2883	567-550·5	4102	1115-1098	1529-1568	2172
	154	131-132	153-154	154	150	137-135	136-134	143	124-123	137	105	103	48
53·5	16·87	12·5-12·7	14·5-14·3	14·4-13·7	15·2-15·2	11·4-13·1	3·2-3·16	20·1	4·57-4·4	23·3	16·6-10·4	14·8-15·2	45·2

The first column represents the mean of the ages—*i.e.*, 53.5.

The first line represents the sum of the measurements.

The third line represents the mean of the measurements.

^a Outer occipital protuberance higher than the inner.

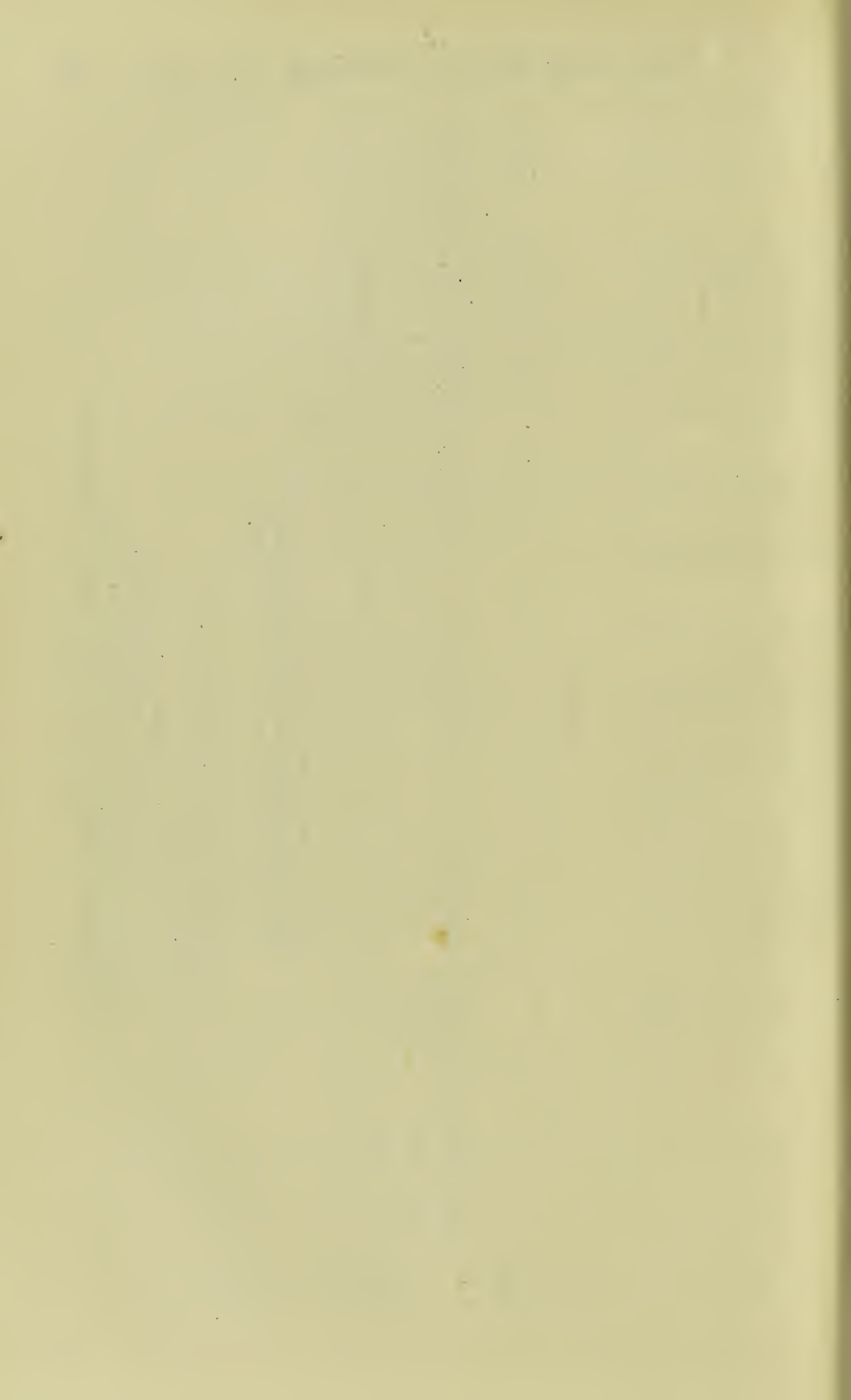
^b Large frontal sinuses.

^c The inferior longitudinal sinus passes to right lateral.

^d The outer occipital protuberance higher than the inner.

^e The outer occipital protuberance much higher than the inner.

^f A well-marked ridge sinus across the inferior fossa of the occipital bone.



OBSERVATIONS ON THE DIAMETERS OF HUMAN VERTEBRÆ IN DIFFERENT REGIONS. By R. J. ANDERSON, M.A., M.D., *Demonstrator of Anatomy, Queen's College, Belfast.*

THE measurements of the bodies of vertebræ were made with a view to determine their relations in various regions, and to the diameters in other regions.

The vertical diameters of the cervical region in front and behind were generally the same—a fact generally recognised. In the dorsal region the anterior vertical diameter is generally less than the posterior. The difference is less above. In the lumbar the anterior diameter may be equal to, greater, or less, than the posterior, always excepting the last. The diameters were measured with a millimetre rule. Most anatomists recognise the fact that the lumbar curve is mainly due to the intervertebral cartilages, but the actual in the anterior and posterior diameters are given differently by different authors. The vertical diameter (anterior) increases from the 3rd cervical to the last lumbar 14 m. to 29 mm. (Henle).¹ The posterior vertical does not maintain the same steady increase in the dorsal and lumbar regions as the anterior. In the lumbar region a diminution is observable. Thus, in the mean of thirty measurements, the posterior vertical diameter of the second gives 27·4 millimetres and 22·2 in the 5th lumbar. And in the mean of fifty measurements the sum of all the anterior diameters in the lumbar region does not exceed greatly the posterior sum, and this although the anterior diameter of the 5th lumbar exceeds greatly the posterior.

The antero-posterior diameters increase from the 3rd cervical to the 3rd lumbar. But in the cervical region this increase is much slower than in the dorsal region, whilst in the lumbar region the antero-posterior diameter of the fifth and sometimes of the fourth are less than the third. The means of two series of measurements are given. In the first series the antero-posterior was taken from the anterior part of the body to the

¹ Knochenlehre, p. 37.

anterior part of the vertebral foramen. In the second series the measurement was made from the anterior part of the body to the line drawn across the points where the arch rises from the body. The latter measurements differ but little from the former in the cervical and lumbar regions but much in the dorsal.

The maximum transverse diameters vary in position in different regions. They are placed farther back in the upper dorsal region, and approach the middle of the antero-posterior diameter as they are followed upwards or downwards.

The antero-posterior and transverse diameters are most nearly equal from the 5th to the 8th dorsal vertebræ; above and below the antero-posterior are much less.

In the mean of the transverse the 5th dorsal has the smallest. A gradual increase takes place from the 2nd cervical to the 2nd dorsal vertebra, then a diminution to the 5th dorsal, and this is succeeded by an increase which goes on to the 5th lumbar.

In certain parts of the dorsal region in most of the vertebral columns examined, the bodies were found not to be equilateral. As a rule, the right sides of the bodies are greater than the left, from the 7th to the 10th dorsal vertebræ. This may hold for all the vertebræ lying between the 3rd and 11th. Sometimes, with a large right side from the 7th to the 10th, a large left side is present in the upper dorsal region.

This unilateral enlargement is probably due to the lateral curvature. The greater weight of the viscera on the right side is, without doubt, an element in these cases. In the former case the bodies of the vertebræ are at the right sides less curved, and the antero-posterior diameter of the bodies are placed a little to the right of the median line.

The transverse diameters of the bodies of the dorsal vertebræ of most animals that I have examined exceed the antero-posterior. The exact relations I hope soon to publish.

In the following table will be found:—

- A. The vertebral column of an adult where the largest measurements were found.
- B. The vertebral column of an adult where the least measurements were found.
- C. The means of the transverse diameters of the bodies of fifty-three vertebral columns.

D. The means of the antero-posterior diameter of the bodies of twenty-eight vertebral columns.

E. The mean of antero-posterior diameters of twenty-five vertebral columns.

F. Anterior, and

G. Posterior vertical diameters in different regions.

A table is added with the mean of collective heights.

The measurements given above point to the following conclusions :—

- (1.) The anterior vertical diameters of the vertebræ, from the 1st dorsal to the 3rd lumbar inclusive, are less than the posterior.
- (2.) The anterior vertical diameter of the 4th lumbar is equal to its posterior, and in the 5th it is greater.
- (3.) The transverse diameters of the bodies increase from 2nd cervical to 2nd dorsal, then diminish to 5th dorsal, then increase to last lumbar.
- (4.) The antero-posterior diameters increase gradually from 3rd cervical to 3rd lumbar, and then diminish.
- (5.) The non-equivalence of the lateral parts of the bodies is generally observable from the 7th to the 10th dorsal, but may extend to the 3rd and 11th vertebræ.

TABLE.

		A.				B.				C.	D.	E. Antero- Posterior Diameter, XXVIII.- LII.	F.	G.					
		T.	A.	H.		T.	A.	H.					Vertical Diameter of I.-XXXI., omitting XXX.						
				Anterior.	Posterior.														
				a.	b.			a.	b.										
Cervical	2.	21	17	22	..	14	14	18	..	19·0	15·6	15·4	19·5	..					
„	3.	23	16	13	..	18	14	13	..	19·9	15·2	14·9	12·4	..					
„	4.	23	15	13	..	19	13	12	..	21·7	15·7	15·4	12·2	..					
„	5.	25	16	15	..	19	14	12	..	23·0	16·2	15·0	12·1	..					
„	6.	30	18	12	..	21	15	11	..	25·2	17·8	16·4	11·5	..					
„	7.	30	19	14	..	23	14	12	..	27·5	18·3	16·9	13·0	..					
Dorsal	1.	31	17	16	17	25	14	14	16	27·9	17·3	17·4	14·8	15·9					
„	2.	30	19	18	19	23	17	17	18	28·2	17·6	18·9	16·8	17·4					
„	3.	31	22	17	19	24	15	15	18	26·3	19·6	20·5	17·6	18·2					
„	4.	29	27	18	20	22	19	18	20	26·0	22·0	23·2	17·8	19·2					
„	5.	30	28	19	22	23	22	16	20	25·9	24·2	23·9	17·8	20·2					
„	6.	30	30	20	23	25	23	18	20	27·4	25·6	25·3	18·1	19·9					
„	7.	32	31	20	25	26	25	18	21	28·8	26·8	26·5	18·5	20·6					
„	8.	33	33	22	25	27	25	18	22	30·1	28·2	28·3	18·9	21·6					
„	9.	34	35	22	25	28	26	19	22	31·9	29·4	28·2	19·7	21·9					
„	10.	40	37	23	25	30	27	22	23	34·1	29·4	29·4	21·0	22·9					
„	11.	45	37	23	28	32	27	22	24	36·5	29·8	29·8	21·9	24·9					
„	12.	45	35	23	29	33	25	25	26	40·5	30·0	30·8	23·6	25·4					
Lumbar	1.	51	37	25	29	37	25	25	27	42·2	29·9	31·1	24·6	26·5					
„	2.	53	43	26	28	40	26	25	25	44·0	31·9	31·2	25·9	27·4					
„	3.	57	44	28	28	43	29	25	25	47·7	36·8	32·2	26·7	27					
„	4.	57	43	26	26	43	27	26	22	48·3	33·8	31·4	26·1	26·0					
„	5.	63	44	30	24	43	29	27	20	52·7	36·5	31·3	27·2	22·2					
T.—Transverse diameter. A.—Antero-posterior. H.—Vertical diameter. { a. antero- { b. posterior.										MEAN OF HEIGHTS.									
										Anterior.					Posterior.				
										80·0					..				
										222·3					245·0				
										132·9					128·3				

N O T E S

ON A

CASE OF ABNORMAL ARRANGEMENT OF THE PERITONEUM.

BY

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MDCCCLXXVIII.

NOTES

ON A

CASE OF ABNORMAL ARRANGEMENT OF THE PERITONEUM.

A MALE subject, brought to the Rooms during last session :—

Peritoneum healthy ; stomach, duodenum, liver, spleen, pancreas and large intestine normal in position and peritoneal covering. Jejunum and ileum, with the exception of the lower four inches of the latter contained in a sac, having the following relations :— Above, it was bounded by the spleen and pancreas, but separated from them by the transverse mesocolon ; below, it extended downwards to the iliac fossa, its long axis, however, being directed downwards, forwards, and to the right, and attached by slight adhesions to the right groin. Internally, it became narrower, and terminated at the anterior surface of the aorta, over the origin of the inferior mesenteric artery ; in this position it was constricted. Externally, it was bounded by the descending colon. The anterior surface was free. Posteriorly were the kidney, quadratus lumborum, and psoas muscles.

Arrangement of Vessels.—The superior mesenteric artery supplied the ascending colon from its right side as usual, the ilio-colic, right colic, and middle colic arteries being normal in position and relations. The arteries to the small intestines disappeared through an aperture in front of the aorta, passing thus to supply the jejunum and ileum. The veins collecting the blood from the parts supplied by these arteries united in the superior

mesenteric vein, which accompanied the artery of the same name. The inferior mesenteric artery arising from the aorta, one inch and a half from its commencement, gave off the left colic branch, which took a direction upwards over the neck of the sac, then upwards and to the left, and then outwards over the sac. The sigmoid and hæmorrhoidal arteries coursed beneath the posterior parietal peritoneum to their regions of distribution; the former being situated also behind the sac. The inferior mesenteric vein was situated behind the posterior parietal peritoneum during its whole course, and received its left colic tributary at the upper margin of the aperture of the sac. The latter having separated from its left colic artery at the junction of the middle third with the upper third of the aperture. The neck of the sac was thus bounded by the aorta and the inferior mesenteric artery behind, and by the left colic artery and left colic vein in front; the junction of the left colic artery with the inferior mesenteric being situated at its lowest part, and that of the left colic and inferior mesenteric veins being situated at the upper part of the aperture. An incision 3 to 4 inches in length was made external to, and independent of the opening. The small intestines were free, and no adhesions observed. The sac was 8 inches in length, 4 in breadth, and lined with a serous membrane. The wall in front of the sac was found to consist of two layers, which were separated readily and completely from each other. The superficial layer was continuous with the peritoneal covering of the left colon, and therefore with the general peritoneum. The inner layer formed a complete sac continuous at its neck, in front with the outer layer, and behind with the peritoneum of the posterior wall of the abdomen and the mesentery. Thus the free surface of the wall of the sac was continuous with the free surface of its internal layer, the marginal fold containing the left colic artery and vein. The cavity of the sac became narrower on being traced to the middle line, and communicated with the abdominal cavity by an aperture 2 inches in length from above downwards, closed by adhesions which were readily broken up. The posterior wall of the sac, containing the jejunum and ileum, was covered with a layer of felted connective tissue, from which patches could be removed; but a definite membrane could not be demonstrated at that part.

Many theories have been proposed to account for abnormalities of the above character. In a previous number of this *Journal*¹ will be found a description in accordance with alterations which take place in the abdominal contents during foetal life.

Huschke described² a fossa, called by him "fossa duodeno-jejunalis," limited, above, by the posterior layer of the transverse mesocolon, internally, by the duodenum, and bounded at the left side by a sharp falciform marginal fold. The fossa was well seen in a female subject dissected during the present session in the Anatomical Rooms, Queen's College, Belfast, of which the following is a description:—The transverse colon, with its mesocolon, being drawn up, the peritoneum was found free from adhesion. On turning over the jejunum to the right side, so as to expose the duodeno-jejunal flexure, a fossa was observed, 2 inches in extent from above downwards, and about one inch in depth, bounded by the duodenum internally, and by the aorta internally and behind, a large falciform fold forming the outer boundary. The upper cornu of the fold was continuous with the peritoneum of the posterior layer of the transverse mesocolon, the inferior cornu with the peritoneum covering the duodenum. The external surface of the fold was continuous with the internal layer of the descending mesocolon; the internal surface of the fold was continuous with the peritoneum covering the aorta, *i.e.*, with the posterior parietal peritoneum. *In* the fold the left colic artery coursed for two-thirds of its extent. The inferior mesenteric vein was crossed by the left colic artery below the fossa, and afterwards arched inwards *beneath* the fossa. In the fossa one inch of intestine was found.

In a subject dissected in the Anatomical Rooms last winter the fossa contained two inches of intestine, and was sufficiently large to have contained four inches of the bowel.

Treitz, from a minute and extensive examination of similar cases, was led to the conclusion that the inferior mesenteric vein lies usually *in* the falciform fold, and not *behind* the fossa, as described by Huschke, and Luschka adopted this description. The fossa has the following relations:—It is bounded by a fold

¹ Dr Cleland in *Journ. of Anatomy and Physiology*, ii. 201.

² Sömmering's *Lehre von den Eingeweiden*, von Huschke, pp. 215, 216.

of peritoneum embracing the two folds (duodeno-mesocolic of Huschke), and the posterior parietal peritoneum covering the aorta, and extending from that vessel to the left. In the inferior cornu courses the left colic artery, and in the superior the inferior mesenteric vein. These vessels crossing at a sharp angle, a vascular arch is thus formed, with its concavity inwards.¹

The development of the fossa is easily accounted for. At a time when the liver is large, and occupies both hypochondria, the alimentary canal is mesial. When the liver becomes smaller (relatively), and comes to occupy the right hypochondrium, the pyloric end of the stomach and the duodenum are drawn to the right, the upper and lower transverse parts of the duodenum being thus produced. The peritoneum in the neighbourhood of the duodeno-jejunal flexure is also drawn to the right side; and in this way, in consequence of the loose tissue beneath the posterior abdominal peritoneum in that situation, the fossa and the plica duodeno-jejunalis is produced. The movement of the colon does not compensate for the movement of the duodenum, but rather tends to throw into relief the prominent border of the fold (Treitz).²

The relations of the fossa duodeno-jejunalis to, and its bearing on, the case of the abnormality instanced will be seen on comparing the boundaries in each case. If the vascular arch be situated close to the margin of the fold, anything tending to increase the weight of a piece of intestine pressing upon the fossa will also tend to increase its size. The larger the piece of intestine in the fossa, the more effective will the pressure be. An experiment suggested by Treitz will show with what ease such an action may take place. Take a dish with a high border, place it upon a table, and in its neighbourhood place a quantity of small intestines. If now an end of the intestine be drawn over the margin of the dish, and a small quantity of water be poured therein, the whole intestine may be drawn into the dish. A very similar condition obtains in the duodenum. A quantity of fluid is frequently transmitted from the duodenum through the duodeno-jejunal flexure. If a portion of intestine be contained in the fossa, a certain pressure is exercised which will tend to

¹ Luschka, *Die Anatomie des Menschen*, iii. 152.

² *Hernia Retroperitonealis*, von W. Treitz.

enlarge the fossa. The pressure will be still more effective if it be assisted by violent motion of the body, such as takes place in riding on horseback. Lying on the left side, *cæteris paribus*, as in one case noted by Treitz, would also favour the ingress of the intestine. The rapidity of the passage of the intestine into the fossa would thus increase with the quantity that has passed in, whilst its return is prevented by the same means.¹

In conclusion, I desire to express my thanks to Prof. Redfern for much assistance in the preparation of this description.

¹ For additional cases consult J. Chiene, this *Journal*, 1868; W. Gruber, *Virchow's Archiv.*, 1868; P. H. Pye Smith, *Guy's Hospital Reports*, 1870.

NOTES

ON A

DISSECTION OF A CASE OF EPISPADIAS.

BY

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NOTES

ON A

DISSECTION OF A CASE OF EPISPADIAS.

THE pelvis had been divided on each side of the middle line in front of the acetabula. The anterior wall of the abdominal wall is complete. The depth of the symphysis or its representative is half an inch, the distance between the pubic bones half an inch, the space between being filled with fibrous tissue. The bones are very movable at the joint. Below the pubes the skin passes into mucous membrane at the front and sides, and a funnel-shaped opening leads into the bladder. This opening is situated below the pubes at a distance of three quarters of an inch from the upper border of the fibrous band. Below the orifice is situated the penis, three inches in length, flat and grooved on the upper surface. The groove extends the whole length of the organ, and becomes somewhat wider near the anterior extremity. Near the anterior extremity two lateral grooves or fissures are situated, each three quarters an inch in length. Foramina are to be seen on the floors, and by drawing the penis forwards the openings of the ducts of Morgagni and the verumontanum come into view. The penis is terminated by a glans, bordered by a prepuce with a frænum; the former is confined to the lower surface, and is at the frænum one inch in length; but it diminishes towards the sides. On running the finger and thumb along the penis, the corpora cavernosa can be felt as two separate bodies, but more distinctly behind than in front. At a distance of three quarters of an inch behind the anterior extremity of the penis, they become more closely united, and immediately in front of this a slight change in the resisting power of the tissue is felt. The scrotum is large, and the testes

can be felt on each side; these bodies are small (age of subject, 84). The perinaeum is perfect behind the scrotum.

The bladder is of moderate size and the walls of normal thickness. An opening above and behind shows the mucous membrane to be slightly tinted red. The ureters have the usual position, their ducts open one and a half inch behind the pubes. The verumontanum is best seen by drawing the posterior wall of the bladder back; it forms a considerable elevation, which is greatly increased by injecting water into the vas deferens of either side. The openings of the ducts are situated near the upper border of the elevation, and close to one another. The vasa deferentia are somewhat increased in size as they descend on the posterior wall of the bladder; each is joined by the vesicula of its own side. The latter receptacles are somewhat smaller than usual. The prostate is large, and bounds the neck of the bladder behind and slightly at the sides. It is firm on pressure.

The erectores penis and ejaculatores urinæ are present; the latter present a somewhat flattened appearance. Their attachments do not deviate materially from the usual condition. The crura are fixed behind in the normal position, and pass forwards and inwards, and widen slightly behind the glans on passing air into each crus; it does not pass into the glans nor from one side into the other.

The corpus spongiosum, smaller than usual, is situated in the middle line between the crura, and diminishes in size anteriorly; less than half an inch wide behind, it is less than a quarter of an inch at the junction of the crura, and is continued forwards between these bodies.

The triangular ligament is well formed and firm. The subpubic opening will admit the index finger on pressure, but it is not patent.

Dissections of epispadias with and without ectopia vesicæ have been previously made, and accounts of these and other cases have been recorded.¹

The abnormality may be accounted for by referring the

¹ Professors Humphry, Turner, and Cleland, *Journ. of Anatomy*, vols. iii. and v.

condition to an arrest of development or failure of lateral parts to meet in the middle line, or by supposing rupture to take place at an early period. That failure of the lateral parts to meet in the middle line cannot sufficiently account for the presence of the ectopia vesicæ, which so frequently occurs with epispadias, Professor Cleland has shown, unless indeed the view of Reichert and Remak¹ be adopted, that the allantois is developed by two processes, which subsequently afterwards coalesce. And if this view be adopted, it will be necessary to assume their incomplete coalescence.² Vrolik³ considers the presence of ectopia vesicæ with a partial epispadias, as in Baillie's case, where the posterior part of the urethra was bridged over, an argument against the hypothesis of rupture. That, however, urine must appear in the abdominal cavity in case of rupture, does not necessarily follow if close apposition of the urinary tube with the abdominal wall have previously taken place. The fringed borders were absent in the above noted case and others. The corpus spongiosum, it will be seen, has a position between the crura and the corpora cavernosa. The body was narrow, yet the breadth of the flattened penis was increased. The corpus spongiosum was inflated for some distance (2-3 inches) from the bulb. Three facts especially deserve attention. The position of the prostate, which is almost confined to the posterior (inferior) part of the bladder; secondly, the high position of the urethral orifice; and thirdly, the condition of the urethral groove. All these point to a transference of the urinary orifice forwards. A displacement backwards of the tube from the upper level of the prostate to the anterior extremity of the groove, without alteration in the position of the corpora cavernosa, would reduce the parts to the normal position, provided that the corpus spongiosum be moved back also for some distance. Hence, in the above case, without reference to ectopia vesicæ, there is evidence of a dislocation forwards of the urinary passage from the prostate (posterior border) to the extremity of the urethra. If, then, at a period when the crura

¹ Foster and Balfour, *Embryology*, p. 148.

² See Budge, "Ueber die Harnblase bei Vogelembryonen."—*Deutschen Med. Wochenschr.*, No. 8, 1881.

³ Frolik, *Cyclop. of Anat. and Physiology*.

have not yet united, the septum between the intestine and the urino-genital tube be completed, and the orifice of the latter be placed farther forwards than usual, unless indeed a corresponding change take place in the position of the crura, the latter will come to occupy the posterior part of the orifice, the corpus spongiosum may have its free development interfered with, and the urethra will be incompletely covered. The urethral opening, taking the average of 22 cases, male and female, was situated $2\frac{1}{2}$ inches below the upper border of the symphysis; in the case of epispadias, the distance was three quarters of an inch.

The condition of the ectopia vesicæ may be referred to the same cause. If the opening of the primitive urinary tube be placed very much farther forwards than usual, namely, in a part where active increase in the tissues takes place, a foramen which would remain relatively small if maintained in the ordinary position, may become large by participating in the growth of the tissues, or by representing an amount of tissue absent. And the increase of the bladder which gives this viscus its character would be very different when compared with an opening placed higher up than the usual position.

Baillie's and Luschka's cases may be explained by the fact, that the corpus spongiosum is more free behind.

THE
MORPHOLOGY
OF THE
MUSCLES OF THE TONGUE AND PHARYNX.

BY
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THE MORPHOLOGY

OF THE

MUSCLES OF THE TONGUE AND PHARYNX.

ACCOUNTS have been given of the muscles of the tongue with a view to determine their position and relations (morphologically) to the surrounding parts. These have generally been regarded by anatomists as useful in acquiring a knowledge of the muscles rather than exhaustive inquiries into their exact relations.

The tongue seems to be a special appendage of the pharynx, for although it is first to be recognised in the chick as an elevation in the floor of the mouth, it receives only its mucous covering from the epiderm. The tongue is placed in relation with the first, second, and third arches at its earliest appearance, and in front (or below) the primitive digestive tube, a position which it maintains in the adult. The development of the air tube also limits the area of formation, and its connection with the visceral arches formed in connection with the pharynx, as well as the relations of the parts in the adult, point to a similarity existing between the muscles of the pharynx and those of the tongue.

The muscles uniting the derivatives of the visceral arches with the base of the skull may be stated as follows:—Muscles uniting the base of the skull with the first arch,—the internal and external pterygoids (in part), the tensor palati, and laxator tympani; the base of the skull with the second—the stapedius (formed in connection with second); first with second—an occasional bundle of stylohyoid; first with third—the anterior belly of the digastric geniohyoid and geniogloss; the second and third—stylohyoid, and occasional slip of stylopharyngeus; third with the base of the skull—posterior belly of the digastric.

The latter serves to unite the base of the skull in some animals with the first as is well known, and occasional slips in man have been seen. The septal muscle, situated between the genioglossus of opposite sides, may be regarded as a hyomaxillary or accessory genioglossus.

The connections of the pharynx and tongue with the base of the skull are as follows:—The pharynx is connected to the base of the skull by a true cephalo-pharyngeus (occasionally present), the levator palati and a portion of the tensor palati by means of the palato-pharyngeus; to the first arch by means of the superior constrictor; to the second and third arches by means of the middle constrictor and stylopharyngeus. The tongue is connected with the base of the skull by the tensor palati through the palato-glossus to the first arch by means of the styloglossus (occasional slip) and genioglossus; to the second by means of the styloglossus and chondroglossus; to the third by means of the keratoglossus and basioglossus. The inferior lingualis may be placed in the last-mentioned set. The septal muscle already referred to, which is single (Henle), or double (Luschka), and which is rarely absent according to Bochdalek, may be considered an additional hyoglossal muscle developed in the fibrous tissue of the septum.¹

The varieties of the tongue and pharyngeal muscles present many points of interest in this connection. A styloglossal slip (and sometimes the whole styloglossus muscle) arises from the inferior maxilla; an example of the former occurred in a subject dissected during the present session. The maxillary slip was half-an-inch broad at its origin, and partially connected with the internal pterygoid; the organ was tendinous. An accessory stylohyoid muscle was present on both sides of the body, the stylohyoid ligament being also present, which had connections similar to the muscle. A slip has been seen passing to the pharynx (Sandifort).² In a female subject, aged seventy, on the left side a slip from the posterior border of the styloglossus passed over the stylohyoid ligament, and was continued into the fibres of the middle constrictor. Professor Gruber has seen a slip from the external auditory meatus to the tongue. A slip from the

¹ Henle's *Eingeweidelehre*, p. 106.

² Macalister, *Trans. Roy. Irish Academy*, vol. xxv.

corpus triticeum has been seen to pass to the tongue separately or in connection with the keratoglossus.¹ In one case, in which the lingual artery passed over the keratoglossal fibres, a stylohyoid muscle replaced the ligament of the same name, gave a slip to the posterior thyrohyoid ligament, and a thin band to be inserted into the great cornu of the os hyoides; on the opposite side of the body the muscle replaced the ligament also. In this case the middle constrictor fibres, destined for the lesser cornu of the hyoid bone, passed over the lingual artery and beneath some fibres of the hyoglossus. The palato-glossal fibres are continued into the transverse fibres of the tongue.

The Pharyngeal Muscles.—The superior constrictor has been seen to give fibres to the mylohyoid at its attachment to the inferior maxilla and to the buccinator at its buccal attachment. The lower fibres have been seen to pass into the genioglossus and hyoglossus. They are stated by Professor Henle to pass into the transverse fibres² in front of the palato-glossal fibres. The results of several dissections lead me to believe that they are continuous, at least in great part, with the genioglossal fibres. The middle constrictor receives sometimes a slip from the base of the skull. This variety occurred during the present session. The slip was attached above to the vaginal process of the temporal bone, external to the attachment of the levator palate, and part with the middle constrictor, in part separately reached the middle line posteriorly. This muscle and also the middle constrictor have been seen to receive slips from the thyrohyoid. In a case already referred to, the middle constrictor received a bundle from the posterior border of the styloglossus, and sent a bundle with the styloglossus to the tongue. The stylopharyngeus has been seen to give off a bundle to the styloglossus, and to be inserted into the uvula, epiglottis and thyroid cartilage.

The normal connections of the muscles of the tongue and pharynx, taken with the variations sometimes met with, point to an intimate relation existing between those of the former and those of the latter. The continuity of the pharyngeoglossal fibres with those of the transverse lingual and genioglossal fibres

¹ *Op. cit.*, p. 108.

² Macalister, *op. cit.*

seem to show that the latter are developed from the differentiated inner layer of the digestive tube, and in the same set may be placed the palato-glossus. The normal attachments of the middle constrictor to the hyoid bone and its styloid connection, together with its occasional attachment by a slip to the inferior maxilla, seem to show that this muscle may be considered as derived from the same pharyngeal differentiated mesoblast layer, as the styloglossus and hyoglossus and inferior lingualis. The interchange of fibres, and their variation of attachment, point in the same direction.

The superficial lingual muscle is probably developed from the covering of epiderm, and is comparable with the subcutaneous muscles of other regions.

The nervous supply of the parts bears out generally the homology. The muscles are supplied in one case by the hypoglossal, in the other by the spinal accessory through the vagus. These nerves may be both regarded as spinal nerves, or as parts of a fourth cranial nerve, of which the glosso-pharyngeal and vagus represent the anterior divisions.¹ The mucous membrane of the tongue is in great part supplied by the fifth, as it is derived from a region supplied by that nerve. The nervous supply of muscles above the level of the distribution of the first mentioned nerves receive the facial or fifth in accordance for the most part with the early distribution of these nerves to the second and first arches. These nerves may be considered as representing a third cranial nerve, of which the greater part of the third represents the sensory part. The fact that the styloglossus receives a branch, sometimes from the digastric branch of the facial, is interesting, when the supply of the other styloid muscles is taken account of.

The vertical lingual fibres, which are not included in the above account, are considered by many as detached portions of the genioglossi, whilst others deny their existence as separate fibres.

The muscles of the tongue have been examined by Meckel² in the various animal classes, and the following represents the general condition as given by him:—

¹ Gegenbaur's *Anatomy*, p. 700, *et seq.* Krause, *Allgemeine und microscopische Anatomie*, p. 403. Krause, *Anatomische Varietäten*.

² *Anatomie*, B. iv.

In *Proteus* of the amphibia there are three pairs of muscles on each side of the tongue bone. Of these the anterior passes from the posterior extremity of the second lateral cornu to the anterior of the first and the anterior of the mesial bone. The *middle*, close to the median line, extends from the anterior and inner end of the second cornu to the mesial bone. The third from the posterior end of the third cornu to the middle of the second cornu.

In *Rana* and *Bufo* a longitudinal, perfectly or imperfectly divided muscle, extends from the posterior cornu of the hyoid bone to the anterior end and the whole circumference of the tongue, which it draws back powerfully. Even though in some the tongue cannot be protruded, the muscles are present.

The muscles acting on the hyoid are as follows :—

The depressor connected more or less with the rectus abdominis. In the tailed batrachia it is this muscle which passes from the inner surface of the clavicle to the posterior extremity of the hyoid bone.

The retractor or omohyoid is attached to the inner surface of the middle or mesial piece of the scapula and the hyoid bone.

The elevator passes from the styloid bone to the upper and posterior part of the second lateral cornu.

The hyomaxillary from the inferior maxilla to the mesial piece of the hyoid or the beginning of the posterior cornu.

A muscle passing from the inferior maxilla of one side to that of the opposite side is also present.

In ophidia, the protractor arises from the anterior extremity of the inferior maxilla, and may be traced to the middle of its whole length.

The retractor arises from the posterior extremity of the tongue bone, and forms almost the whole of the tongue substance.

Near the middle line a special hyomaxillary muscle is present, which goes from the inferior maxilla anteriorly to the posterior extremity of the body of the hyoid. Posteriorly, this muscle passes into another, which is attached to the most anterior ribs and the trunk muscles as far as the spines of the dorsal vertebræ, where it meets its fellow of the opposite side in the median line.

In *Python bevittatus*, the retractor of the hyoid has an opo-

neurotic origin, from the spines of the cervical vertebræ, lying close beneath the skin; it is broader at its origin than at its middle part, and passing obliquely behind and below the inferior maxillary articulation, it converges towards the muscle of the opposite side, and is inserted into the anterior extremity of the tongue bone.

The protractor comes from the cartilaginous connection of the inferior maxillæ, and mixes behind with the hyoglossal muscle; it is inserted into the internal inferior and external surfaces of the hyoid (cornu), and it surrounds the hyoglossus like a sheath.

Between the anterior thirds of the cornua a triangular muscle, with the apex turned forwards, is present; it is thin and membranous; a decussation of the fibres has not been observed.

A muscle comparable with the mylohyoid is present in *Python b.*, which is united posteriorly with the cervico-maxillary muscle. It arises from the inner surface of the inferior maxillæ, and is inserted into the outer part of the hyoid bone. The subcutaneous muscle joins it behind; at first a decussation of the fibres takes place, and then they become continuous. Meckel and Hubner regarded this muscle as the platysma; and the former anatomist gave it the name subcutaneous muscle of the neck.

A muscle is found beneath the posterior depressor of the lower jaw; but farther back, and upon which the retractor of the os quadratum lies, may be regarded as a muscle of the hyoid bone. Its fibres mix with those of the preceding muscle anteriorly, of which it is the antagonist. It may be named the cervico-hyoid.

A muscle arises with the geniohyoid (protractor), separates from that muscle, and is inserted into the air tube, which it draws forward.

A muscle that draws back the larynx arises at the attachment of the geniohyoid and hyoglossus to the bone, close to and above the former, outside the latter, and is inserted into the thyroid cartilage.

The lingualis arises from the hyoid bone posteriorly, and passing forwards joins its fellow of the opposite side in the median line at an acute angle, and by the anterior separation of these muscles the bifid tongue is produced.¹

¹ D'Alton, in *Müller's Archiv*, 1834.

In *Chelonia*, the retractor of the tongue extends from the inner end of the anterior cornu of the os hyoides to the lateral border of the tongue.

A second is found in *Chelone*, more posterior and external, which passes from the anterior two-thirds of the anterior cornu to the lateral border of the body.

A third in *Chelone* beneath the first passes from the small mesial sublingual cartilage into the tongue substance.

The protractor is larger than the latter, but smaller than the other tongue muscles.

The depressor of the hyoid bone arises from the outer end of the clavicle, and goes to the cornua of the hyoid bone. An omohyoid is wanting. The elevator arises from the posterior extremity of the inferior maxilla, and passes from before and without backwards and inwards to the outer end of the anterior cornu. A hyomaxillary muscle is present, and corresponds in its attachment to the whole length of the maxilla, and descends far into the neck.

The protractor is strong, and passes from the place of union of the inferior maxillæ to the inner half the anterior cornu.

In *Crocodilia*, the retractor of the tongue arises from the middle of the bony cornu, and passes into the posterior half of the tongue by six or seven processes.

In *Crocodilia*, the protractor is double. The parts arise from the anterior extremity of the lower jaw, the outer and larger passing along the outer border of the tongue to its posterior extremity. The inner, much smaller, unites towards the posterior part of the tongue with that of the other side, and reaches into the middle round the hinder border.

In crocodiles and other reptilia, the depressor of the hyoid bone passes from the sternum to the hyoid, and sends a process to the inferior maxilla.

The retractor or omohyoid arises from the scapula, and is inserted into the middle of the bony cornu.¹

The elevator moves the bone to the side, and extends from the muscles attached to the inferior maxilla (inner surface), and is inserted by two processes into the lateral border of the hyoid plate, and behind to the outer half of the lateral cornu.

¹ Episterno-hyoideus, Episterno cleido-hyoideus of Saurians.

The intermaxillary muscle passes from one side to the other without interruption. The deep hyomaxillary muscle arises from the middle of the inferior maxilla near the upper border, and is inserted into the middle of the lateral cornu.

In birds, the lingualis is attached to the posterior part of the tongue (glossohyal), and is inserted into the anterior part. Flethy behind, it terminates in a long tendon which passes along the under surface of the tongue close to the median line. The hyoglossus arises from the side of the anterior piece of the mesial part of the hyoid (basihyal), and is inserted near the base of the tongue at the outer part of the upper surface. The ceratoglossus arises from the long posterior cornua surrounded at its origin by the geniohyoid, and terminating in a long tendon, is inserted into the lower surface of the tongue external to the lingualis. The ceratohyoid (ceratoural) arises from the cornu near the anterior part, and meets its fellow of the opposite side in the median line, or is inserted into the posterior piece of the mesial portion of the hyoid. The former condition obtains in the goose, duck, and common fowl, the latter in the parrot. The muscles of the hyoid are the so-called stylohyoid, which arises from the posterior part of the external surface of the inferior maxilla near the lower border, and divides into two pieces, one of which is inserted into the median raphé beneath the urohyal, or into this bone; and the anterior slip passes beneath the ceratoglossus to be inserted into the basihyal beneath the hyoglossus. The geniohyoid arises from the inner surface of the inferior maxilla, and surrounds the posterior cornua at its insertion, forming a sheath for the ceratoglossus. In some birds a muscular band attached with the preceding to the inferior maxilla passes to the median raphé beneath the urohyal. A basithyroid muscle extends from the thyroid cartilage to the basihyal, where it is attached above the hyoglossus. A thin membraneous intermaxillary muscle extends from the lower jaw of one side to that of the other. It is divided into two parts by a median septum. In the parrot, in front of the anterior portion of the geniohyoid, a slip united with the latter at its origin passes inwards to meet its fellow of the opposite side in a median septum, forming thus a groove over which the hyoid apparatus moves. In the same bird a genioglossal slip,

arising from the inferior maxilla near the anterior part, is inserted with the hyoglossus into the tongue.

The lingualis of birds is similar in position and connection to the muscle sometimes (always Bochdalek) present in man at the side of the median line internal to the geniohyoglossus. The hyoglossus of birds occupies nearly the position of the basioglossus of mammalia, very much enlarged and extended in these latter. The muscle named stylohyoid by Professor Owen differs from that attachment of the muscle of the same name, not only at its origin, but at its insertion. The portion inserted into the basioglossus, having regard to the alteration, corresponds more nearly to the styloglossus, or probably to the styloglossus and stylopharyngeus combined; whilst the posterior part represents the stylohyoid, or rather that portion, not present in all birds, which is attached to the posterior mesial part of the hyoid bone. The muscle in birds occupies a position in front of the same named muscle in man. If a displacement (relatively) of the muscle backwards take place with the development of the proximal parts of the second arch, so that the expansion would not only reach the second arch, but pass over the walls of the digestive tube to reach or extend beyond the middle line behind, meeting (or decussating) with the muscle of the opposite side, then a condition approaching that of mammalia would be obtained, a greater relative growth in the breadth of the base of the skull separating the styloid process from the subjacent structures would render the condition identical with that of mammalia as far as one portion of the pharynx is concerned. The extension of the muscular fibres along the cornua of the hyoid bone and the thyroid cartilage would produce the middle constrictor and stylopharyngeus respectively. The pharyngeal fibrous coat would then correspond to the muscular layer of the digestive tube of birds. If with a movement downwards and backwards of the larynx (upper) a shortening of the hyoid cornua (posterior) take place, an extension backwards of the genioglossal fibres, which are already in immediate relation with the digestive tube, will produce that portion of the superior constrictor called mylopharyngeus, whilst a growth forwards will produce the geniohyoid and genioglossus in man. In the parrot, a special band on each side represents

the latter, and in the same bird I have found the geniohyoid proper consisting of two bands on each side. The ceratoglossus of birds, by a similar extension, would produce that portion of the superior constrictor known as glossopharyngeus.

Examples of muscular extensions to fit certain structures for definite actions are not wanting in the animal series. In that of python, given above, a retractor of the os hyoides extends back to the vertebral spines; and a muscle, having a similar action in the os quadratum, reaches the nuchal fascia. The examination of the omohyoid in man and animals show that this muscle may be reduced to a muscular slip, or have an extensive attachment to the scapula and clavicle.

It is of interest to note in this connection that the depressors of the hyoid bone are known to extend (in part) into the tongue as a permanent (sloth) condition, and examples are known where the sternothyroid was continued into the tongue and middle constrictor muscles.

THE PRESENCE OF AN ASTRAGALO-SCAPHOID BONE
IN MAN. By R. J. ANDERSON, M.D., *Demonstrator of
Anatomy, Queen's College, Belfast.*

IN a male subject, aged 34. The lower extremities are well formed. The feet are small and well shaped. When the soft parts of the right foot were removed, the carpus consisted of six bones—the astragalo-scaphoid, os calcis, cuboid, and three cuneiform. The astragalo-scaphoid has an upper surface which is articular behind and non-articular in front. The articular portion occupies rather more than half of the upper surface; it is narrower behind than in front. The outer margin is more prominent than the inner. The anterior and outer angle of the bone is cut off by a vertical plane. This causes the anterior border to be a quarter of an inch narrower than the transverse measurement of the surface half an inch farther back. The anterior portion of the upper surface is non-articular, and in front reaches the head of the bone; it is convex from side to side, and perforated by numerous foramina. The posterior surface has the markings usually observed on the posterior surface of the astragalus. The external surface is partly articular and partly non-articular. The articular part forms a triangular facet with which the fibula articulates. The lower part of the surface is bent outwards, so that the surface looks upward as well as outwards. The anterior part of the external surface is non-articular and corresponds to the outer portion of the neck, which, however, is not so well marked as in the astragalus. The inner surface has a pyriform articular facet, such as the astragalus possesses. A rough surface is situated below, and a large rough surface in front of this. The inner articular surface is more prominent than that on the outer side of the bone.

The inferior surface has a large facet behind, which is concave from side to side, and articulates with the facet on the upper surface of the os calcis. In front of this and corresponding to the middle third of the inferior surface is a rough depression. At the centre of this depression a small elevated facet is situated. It measures a quarter of an inch from side to side,

and two lines from before backwards. This articulates with the facet on the upper surface of the sustentaculum tali. In front of the rough depression is the lower surface of the head, which is broader from side to side than from before backwards. The surface is flat. The upper surface of the head of the astragalo-scaphoid is convex from side to side and rough. The inner surface is rough and non-articular; the outer surface possesses a facet for articulation with the cuboid. This facet encroaches upon the inferior surface. The inferior surface is partly articular and partly non-articular. The inner two-thirds is rough and non-articular, the outer third is articular and is occupied by the facet for the cuboid. The anterior surface is articular and has three facets, each wider above than below. Ridges separate these facets one from the other and the outer facet from that for the cuboid. The anterior surface is convex from side to side and from above downwards, and has a small non-articular part near the middle of the lower border. Thus the long diameter of the anterior articular surface is from side to side, the short diameter from above downwards, its inferior border convex, its lower border slightly concave. The outer extremity of the head is thicker than the inner.

The os calcis does not differ much from the ordinary condition of this bone. The upper surface is partly articular and partly non-articular. The large posterior facet for the astragalus is convex from before backwards and from within outwards. In front of this surface is a rough depression which is narrow internally and behind, and so wide externally as to occupy the whole of the anterior portion of the upper surface. This surface gives attachment to the interosseous ligament posteriorly. Surmounting the sustentaculum tali is a facet which articulates with a corresponding facet on the astragalus. This facet is separated from the large posterior facet on the upper surface by a groove. The anterior surface is double curved, and articulates with the cuboid. The remaining surfaces present no features of interest.

The head of the astragalo-scaphoid is received into a cavity formed by the three cuneiform and the cuboid. The articular surface on the inner part of the latter bone is large, and is placed edge to edge with the articular facet on the posterior

part of the external cuneiform. The articular surface of the internal cuneiform is deeply concave, the posterior articular surface of the middle and external cuneiform much less so. The articular facet of the cuboid is concave, and separated by a ridge from the articular facet for the external cuneiform. Almost the entire external surface of the cuboid is therefore articular.

The cuneiform, cuboid, metatarsal, and phalangeal bones present the usual characters.

The left foot possesses likewise six tarsal bones, the astragalus and scaphoid having coalesced to form a single bone. The general characters are those of the astragalus and scaphoid united, with such slight deviations from the form as exist in the right lower extremity. No line of division, however, shows a trace of a previous separation into two bones, and no external signs of any pathological changes are present.

A section of the left astragalo-scaphoid made from before backwards shows that the cancellous tissue resembles that of the astragalus.

An increase or diminution in the number of bones in the carpus and tarsus, though somewhat unusual, has been observed by several anatomists. In the carpus nine bones have been observed, the place of the scaphoid has been occupied by two bones, the semilunar has been replaced by two, an anterior and a posterior (Smith), and the internal cuneiform in the foot by two. A ninth bone is stated by Meckel to exist sometimes between the os magnum and the trapezoid.¹ The radial portion of the scaphoid may be regarded as a radial scaphoid, an os centrale, or as a portion of the scaphoid which represents the os centrale.

In the hand the cuboid and semilunar have been found united (R. Wagner);² in the foot the calcaneum and cuboid, calcaneum and scaphoid, and second and third cuneiform bones. Bones of the sesamoid variety are occasionally found³ in connection with the carpus and tarsus, and the styloid process of the third

¹ Humphry, *A Treatise on the Human Skeleton*, p. 80.

² Heusinger's *Zeitschrift*. t. iii. p. 300. Referred to by Professor Humphry in *op. cit.*

³ Humphry, *op. cit.* p. 80.

metacarpal has been found as a separate ossicle in several instances.¹

In Carnivora, Cheiroptera, and many rodents (*Mus*, *Castor*, *Hydrocharus*), and in many insectivores, a scapho-lunar bone is present. In pteropus of the Cheiroptera, the cuneiform unites with the scapho-lunar in the foot.²

In Crocodilia the scaphoid and astragalus coalesce to form an astragalo-navicular bone. In the Chelonia, whilst in the hand we have nine ossicles, in the foot of chelone, emys, testudo, and trionyx the centrale is united with the astragalus, and in emys the calcaneum coalesces into the astragalus.³

In reviewing, therefore, the various conditions of the bones of the tarsus in vertebrates, it is seen that the os centrale is found united with the cuboid (tragulina and pecora) with the astragalus (chelone), and in some cases the calcaneum is added (emys).

In the carpus, the scaphoid and lunar unite (Carnivora), scaphoid-lunar and cuboid (pteropus), scaphoid and trapezium (sloth and megatherium).⁴

In comparing the bones of the carpus and tarsus, the astragalus may be regarded as the homologue of the lunar (Vicq d'Azyr), or as corresponding to the united scaphoid and semilunar (Gegenbaur). The scaphoid in the foot, on the other hand, may be regarded as equivalent to the scaphoid in the hand, or to a portion of the scaphoid, the radial portion (of Gruber),⁵ or, lastly, as having no single portion of bone representing it in the human carpus. The presence of the divided scaphoid in the case of man, the radial portion of which corresponds to the position of the os centrale of the Quadrumana would seem to favour the second idea.

In the case noted above the astragalo-navicular would then be the homologue of the scapho-lunar bone of the carpus of Carnivora. And the case given by Wagner of the union of the semilunar and cuboid would approach the condition found in the carpus of pteropus, and be similar to the condition in the tarsus of certain of the Lacertilia.

¹ Gruber, *Beobachtungen aus der Menschlichen und Vergleichenden Anatomie*, Heft ii. p. 37.

² Flower, *Osteology of Mammalia*.

³ Huxley, *Anatomy of Vertebrates*, p. 200.

⁴ Owen, *Nature of Limbs*.

⁵ Virchow's *Archiv*. Band lxxiv. p. 433.

ABNORMAL ARRANGEMENT OF THE THYROID ARTERIES. By R. J. ANDERSON, M.D., *Demonstrator of Anatomy, Queen's College, Belfast.* (PLATE XX.).

I. THE INFERIOR THYROID ARTERY.

In a Male Subject.—The right superior thyroid arises from the external carotid near its origin, and divides into two branches—inner and outer.

The subclavian artery gives off the following branches:—The vertebral which has the usual position. The internal mammary is normal in position and relations. The supra-scapular arises from the first stage of the subclavian as a separate branch. The posterior scapular arises from the first stage, and passes behind the anterior scalenus, and between two cords of the brachial plexus. The superficial cervical arises from the first stage close to the origin of the inferior thyroid.

The inferior thyroid is derived from the first stage of the subclavian artery; it arches upwards and inwards, gives off the ascending cervical at a distance of one inch from its origin, and immediately after divides into two branches, superior and inferior. The former passes upwards and inwards behind the sheath of the common carotid and the sympathetic cord, and beneath the right lobe of the thyroid gland, and is distributed to the posterior, lower, and outer part of that lobe. The latter passes in front of the carotid at a lower level than the superior branch, and after a more prolonged course supplies the inner and lower part of the right lobe of the thyroid body, and gives branches to the anterior surface. The above arrangement is easily accounted for by supposing the inferior thyroid to divide nearer to its origin than usual, and the lower branch to pass in front of the carotid artery in place of behind it.

In twelve subjects examined the inferior thyroid arose in one case as a separate branch from the subclavian, in one case from a trunk common to it and the transverse cervical, and in the remaining cases from the thyroid axis. In these cases the inferior thyroid had one of the following arrangements:—it

passed upwards and inwards behind the common carotid as a single trunk, and divided beneath the thyroid body into two or more branches; or, secondly, it passed as a single trunk behind the common carotid, and divided between that artery and the thyroid body into two vessels, one of which (the superior) passed beneath the thyroid body and supplied the posterior and lateral part of the right lobe, and the other (inferior) passed inwards below the thyroid body, and distributed branches to the lower mesial part of the gland, or the inferior thyroid divided outside or behind the carotid, and the two branches passing behind the sheath were distributed as in the last case. In four cases the inferior thyroid divided internal to the carotid. In three cases it divided outside (two), or beneath the common carotid artery (one). In the remaining cases the artery remained as a single trunk, and passed as such beneath the thyroid gland.

The condition of the inferior thyroid artery here noted differs from the third variety in that the second branch passed in front of the common carotid.

An instance is on record when two inferior thyroid arteries were present, one of which passed in front of the common carotid.¹ This case might be considered a variety of the foregoing, in which the division was transferred to the origin of the artery. The other arteries, it will be seen, arose as independent branches from the subclavian in place of the thyroid axis. A change in the relative position of the parts might be supposed to account for them, as well as other arterial abnormalities in connection with the thyroid gland.

An arterial thyroidea ima is known to arise occasionally from the inferior thyroid artery (Gruber), and from the supra scapular (Nuhn and Gruber).² The instances recorded of the latter variety resemble closely the instance above given, as the arteria thyroidea in these cases passed in front of the common carotid.

II. THE SUPERIOR THYROID ARTERY.

In a Female Subject.—The left common carotid divides opposite the upper border of the thyroid cartilage. The external carotid gives off the following branches:—The occipital at

¹ Quain, *Arteries*, p. 170.

² Henle, *Handbuch der Gefäßlehre*, p. 265.

a distance of three-quarters of an inch from its origin. The ascending pharyngeal arises from the posterior surface close to the preceding. The posterior auricular arises at a distance of one inch and a-half from the origin of the carotid. A lingual-facial trunk which arises from the carotid at the same distance from the origin as the occipital artery, and divides one quarter of an inch from the carotid into the lingual and facial branches.

The superior thyroid, which is single, and arises from the common carotid near its termination, passes downwards and inwards, and divides opposite the upper border of the thyroid cartilage into two branches, which are distributed to the inner and outer parts of the anterior surface of the thyroid body. The superior laryngeal branch is given off by this artery at a distance of one inch from its origin, and passes inwards to the thyro-hyoid membrane.

The inferior thyroid of the left side arises from the thyroid axis, and divides into two branches at a distance of two inches from its origin. The upper passes behind the left lobe, and is distributed to its posterior surface. The lower is distributed to the lower and inner part of the left lobe.

The right external carotid gives off the following branches:—The occipital artery arises in common with the sterno-mastoid artery. Both arteries hook round the hypoglossal nerve. The ascending pharyngeal arises from the posterior part of the external carotid close to the occipital. The lingual and facial arteries have the usual disposition. Two superior thyroids arise from the internal part of the external carotid. The upper superior thyroid, which is the larger, passes downwards and inwards, and divides into two branches near the upper border of the thyroid cartilage; of these the inner passes beneath the sterno-hyoid and over the thyro-hyoid, then turns downwards over the thyroid body, and distributes branches to the inner part of the anterior surface and the isthmus, and gives off a crico-thyroid branch at the lower border of the thyroid cartilage. The outer passes beneath the sterno-thyroid, and crosses the right lobe obliquely from above downwards and inwards, and distributes branches to the anterior surface, external to the preceding, reaching as far as the lower third of the gland. A hyoid branch is given off by the upper superior

thyroid, which is directed to the lower border of the hyoid bone. The lower superior thyroid artery courses downwards and inwards to the thyroid body, beneath which it passes, and is distributed to the posterior surface of the right lobe.

The inferior thyroid artery of the right side divides at a distance of one inch and a quarter from its origin into two branches. The upper passes beneath the right lobe, and is distributed to the posterior surface. The lower passes below the right lobe of the thyroid body, and is distributed to the lower and inner part of the gland.

Cases in which two superior thyroid arteries are present must, as Gruber points out, be distinguished from those cases in which one or more arteries, commonly branches of the superior thyroid, are transferred to another arterial trunk. Thus, the superior laryngeal is known to arise from the external carotid and common carotid, and even from the lingual and ascending pharyngeal, and the muscular branches have been seen to arise from an independent trunk whilst the superior thyroid divided into two branches, laryngeal and thyroid (Meckel).¹

In 292 cases Quain found three cases of double superior thyroid arteries, in two of these the superior laryngeal arose as a separate branch from the external carotid.² In the case figured by Tiedemann, the two thyroid arteries came from the external carotid, the lower gave off the dorsalis lingual, the upper the superior laryngeal and sterno-mastoid branch.³ In Lauth's case, also referred to by Gruber, the upper thyroid gave off the superior laryngeal. In Gruber's case the upper, which he calls superior thyroid No. II., was derived from the lingual, the lower, called superior thyroid No. I., was derived from the external carotid.

The instance here given differs, therefore, from the cases above referred to, in that the lower thyroid artery gives off the laryngeal which, in the cases noted by Quain, Tiedemann, and Lauth, arose either as a separated artery from the external carotid or as a branch from the inferior. It differs, on the other hand, from Gruber's case, in that the superior artery was, like the inferior, derived from the external carotid.

¹ Gruber, *Beobachtungen aus der menschlichen und vergleichenden Anatomie*, 2 Heft.

² Quain, *Arteries*, p. 106.

³ Tiedemann, *Tabula*, vii. fig. 1.

A VARIETY OF THE MYLOPHARYNGEUS AND OTHER UNUSUAL MUSCULAR ABNORMALITIES.

By R. J. ANDERSON, M.D., *Demonstrator of Anatomy, Queen's College, Belfast.*

In a Male Subject, on the left side of the body.—The portions of the *superior constrictor* attached to the internal pterygoid plate, the pterygo-maxillary ligament (in great part) and the mouth and tongue are normal in their attachments. The part arising from the mylohyoid ridge (for the extent of one quarter of an inch), and from the maxillary extremity of the pterygo-maxillary ligament (for half an inch) form a band three-quarters of an inch wide, which passes downwards and backwards for one and a half inch. It is at first blended with the superior constrictor, but separates from it as a distinct band at the place of entrance of the stylo-pharyngeus, and immediately divides into two parts. One of these, the larger, passes downwards and backwards, superficial to the middle constrictor; at first, interlacing with this muscle and afterwards becoming continuous with its fibres. The anterior longer and narrower than the preceding, but becoming broad at its insertion, is attached to the posterior border of the thyroid cartilage in a line with, but above the attachment of, the stylo-pharyngeus to the posterior border. The extent of the attachment of the muscle to the thyroid cartilage is three-quarters of an inch.

In a Male Subject, in the right upper extremity.—The *extensor carpi radialis longior* arises from the ridge above the external condyle and terminates in three tendons below the middle of the forearm. The most internal tendon is inserted into the metacarpal bone of the third finger, external to the attachment of the *extensor carpi radialis brevis*. The middle tendon is inserted into the base of the second metacarpal bone. The most external divides into two, of which the inner is inserted into the first metacarpal bone, and the outer gives attachment to a second slip of the *abductor pollicis*. The most internal portion of the muscle can be easily separated from the remainder as high as

the upper third of the forearm, but is distinct from the extensor carpi radialis brevior.

The insertion of an extensor carpi radialis accessorius was described by Mr Wood, and is noted in the list of abnormalities given by Professor Macalister.¹ The muscle described above may be regarded as an extensor carpi radialis longior (having a tendon of insertion into the third metacarpal bone) and an extensor carpi radialis accessorius (Wood) combined.

In a Female Subject, in the left lower extremity.—The *plantaris* is one inch in width at its origin. It arises from the inner part of the posterior ligament and from the inner tendon of origin of the gastrocnemius. The muscular belly terminates in a tendon which passes downwards between the gastrocnemius and soleus, and is attached to the inner part of the tendo achilles.

In a Female Subject, on the right upper extremity.—The *extensor indicis*, which is normal in its origin, terminates in three tendons, of which the inner is inserted into the dorsal expansion of the third finger, and the two outer are inserted into the expansion on the dorsum of the second finger. Cases are recorded where the muscle was inserted into the second and third, and into the second, third, and fourth (Meckel).² The double insertion into the second finger, with an insertion into the third flexor, seems unusual.

In a Male Subject, in the left lower extremity.—The *flexor brevis digitorum* is normal in position and relation. A muscular slip, continuous behind with the muscular belly of the short flexor, terminates anteriorly in a tendon which is inserted into the internal cuneiform by two slips. One slip at the outer and the other at the inner side of the flexor brevis pollicis. The attachments of this muscle are of interest when viewed in connection with the radio carpus. The latter muscle has been seen in close relation with the flexor sublimis digitorum at its origin, and is inserted sometimes into the trapezium.

In a Male Subject, in the right upper extremity.—The muscles of the forearm are normal. A palmaris longus and a palmaris brevis are present. A *radio carpus* is present, which is attached to the lower part of the oblique bone of the radius contiguous to

¹ "Muscular Anomalies in Human Anatomy," *Proc. Roy. Irish Acad.*, vol. xxv.

² Macalister, *op. cit.* p. 106.

the origin of the flexor sublimis digitorum, the muscular fibres which are attached to the posterior surface of the tendon, form a roundish belly three quarters of an inch in diameter, which terminates in a tendon that extends up on the anterior surface of the muscle. The tendon of insertion becomes flat as it descends, and is inserted in the following manner:—internally the fibres are attached to the pisiform and unciform, externally the tendonous fibres are inserted into the trapezium and scaphoid, and the middle fibres into the annular ligament.

A flat muscular band, one inch and a half in width, takes origin from the deep fascia of the forearm three inches above the wrist, and from the tendon of insertion of the previous muscle, descends to the hand and becomes continuous with the fibres of the abductor minimi digiti.

This muscle is a somewhat unusual variety of the radio-carpus. Mr Wood and Dr Macalister found this muscle attached to the annular ligament and co-existing with the ordinary palmaris.¹

N.B.—The example of the radio carpus given above may be regarded as a variety of palmaris.

EXPLANATION OF PLATE XX.

Fig. 1. *ic*, Internal carotid; *ec*, external carotid; *cc*, common carotid; *i*, internal, *e*, external branch of superior thyroid; *s*, subclavian; *ss*, supra-scapular; *sc*, superficial cervical; *v*, vertebral; *it*, inferior thyroid; *ac*, ascending cervical; *a*, internal, *b*, external branch of inferior thyroid.

Fig. 2. *ic*, Internal carotid; *ec*, external carotid; *cc*, common carotid; *f*, facial; *l*, lingual; *o*, occipital; *st*, sterno-mastoid; *sup. t 2*, upper superior thyroid; *hy*, hyoid branch; *sup. t 1*, lower superior thyroid; *l*, laryngeal artery; *sc*, superficial cervical artery; *ss*, supra-scapular; *s*, subclavian; *a*, internal; *b*, external branch of the inferior thyroid artery; *it*, inferior thyroid artery.

¹ Macalister, *op. cit.* p. 91.

Fig. 1.

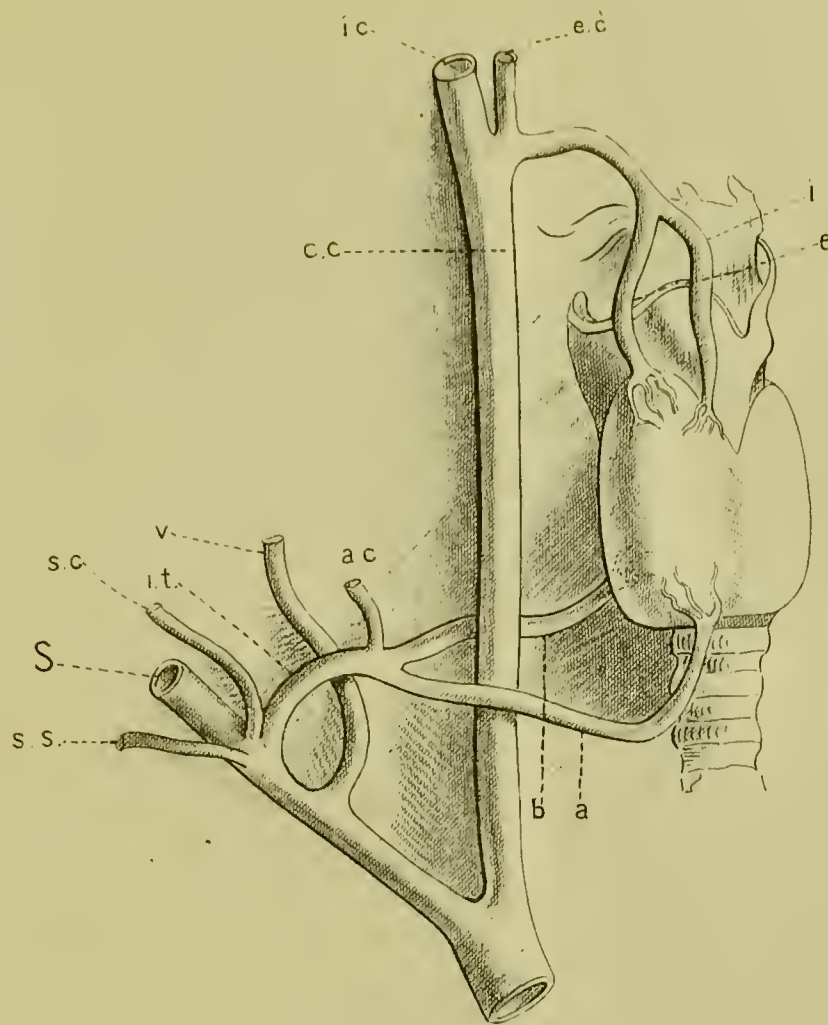
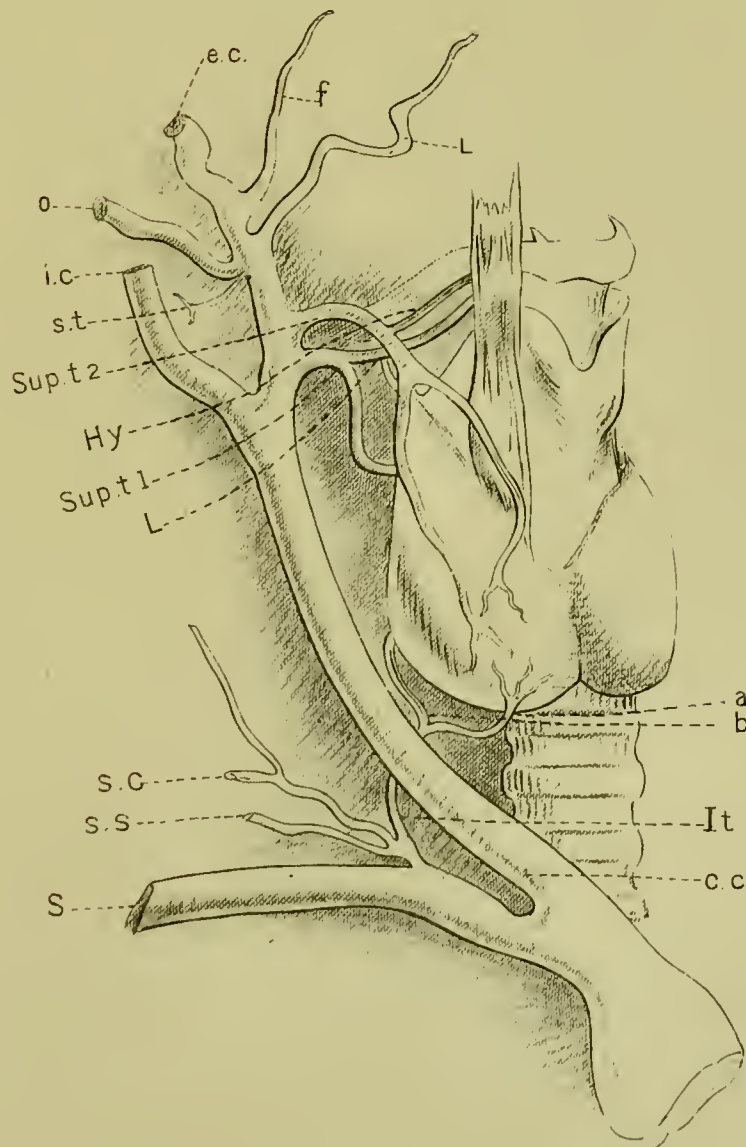


Fig. 2



A PALATINE BRANCH FROM THE MIDDLE MENINGEAL
ARTERY. By R. J. ANDERSON, M.D., *Demonstrator of
Anatomy, Queen's College, Belfast.*

In a Male Subject.—The following arrangement obtains on the right side of the head and neck. The superior thyroid arises one quarter of an inch from the origin of the carotid. The lingual and facial arise by a common trunk three-quarters of an inch in length; the latter gives off the inferior palatine. The *ascending pharyngeal* comes from the posterior surface of the carotid close to its origin. An *accessory pharyngeal* is derived from the external carotid (posterior surface) close to the origin of the facial-lingual trunk. The internal maxillary gives off the tympanic and middle meningeal, the latter the small meningeal; the other arteries are normal in distribution and relations.

On the left side, the common carotid divides in the usual place. The following is the arrangement of the branches of the external carotid:—The lingual arises one inch from the bifurcation. The facial comes from the external carotid one-eighth of an inch higher than the lingual, and gives off the inferior palatine, which passes in between the stylo-glossus and stylo-pharyngeus; before the passage of the artery through the space indicated, it gives off a tonsilar. The

superior thyroid arises close to the origin. The occipital is derived from the external carotid, at a distance of one inch from its origin, and immediately afterwards gives off an *accessory pharyngeal* artery, which first passes upwards between the external carotid and occipital, then lying on the internal carotid it passes with this artery beneath the stylo-pharyngeus, stylo-glossus, and posterior auricular artery, and finally enters the carotid canal. This artery, near its origin from the occipital, gives off a pharyngeal branch that passes downwards beneath the external carotid, facial and lingual arteries, and enters the middle constrictor, an inch higher up a meningeal branch, which goes through the jugular foramen; and finally, before entering the carotid canal, it gives branches to the superior constrictor, and a long branch that enters the internal pterygoid muscle near its posterior (outer) extremity. The sterno mastoid artery is derived from the occipital. The *ascending pharyngeal* arises from the external carotid close to its origin, passes upwards on the inner side of the internal carotid, and distributes branches to the pharynx and anterior spinal muscles. A meningeal branch also is given off by this artery, which goes through the foramen lacerum medius, and finally a palatine branch.

The internal maxillary artery arises below the condyle of the lower jaw, and passes forwards and inwards over the external pterygoid. The tympanic arises from the external carotid, and ascends to the Glaserian fissure.

The middle meningeal arises from the internal maxillary, and passes upwards to the foramen spinosum. Three lines from its origin it gives off a branch, whose calibre is nearly equal to that of the continuation of the meningeal. Derived in this way from the middle meningeal, this artery passes downwards beneath the internal pterygoid between this muscle and the superior constrictor, turns round the border of the tensor palate, and divides into two branches, one of which (the upper) is distributed to the soft palate, the other to the pharynx. This artery gives off the small meningeal at a distance of one line from its origin. The small meningeal, before its passage through the foramen ovale, distributes some small twigs to the external pterygoid, and gives off a branch of more considerable size that anastomoses with a branch of the palatine artery. Near the tensor palate, the palatine artery gives off a branch that passes upwards in relation with the internal pterygoid, then comes into contact with the tensor palate, and divides into two branches, one of which, after giving off small muscular branches to the tensor palate near its origin, breaks up into small twigs that enter the external pterygoid plate; the other branch gives also some muscular twigs to the tensor palate, and finally perforates the sphenoid above the scaphoid fossa; before entering the sphenoid, a communication takes place between this artery and the small meningeal. Of the two terminal branches of the upper part of the palatine artery, one passes along the free, the other along the attached border of the soft palate.

The inferior dental artery arises from the first part of the internal maxillary, and gives off the mylo-hyoid branch. In the second stage,

the anterior and posterior temporal, buccal, and masseteric arteries are given off. The posterior dental and infraorbital arise by a common trunk from this portion of the internal maxillary—a not unusual variety. In the third stage, the internal maxillary gives off the descending palatine, and divides into three branches for the nose, pterygo-palatine and vidian foramina.

Many of the anomalies recorded above are frequent. The occasional presence of an accessory pharyngeal artery is recorded by Mr Quain,¹ Weber,² and other anatomists. A branch of the ascending pharyngeal that passes through the carotid foramen and supplies the dura mater near the sella turcica or the wall of the cavernous sinus, has been mentioned by Quain and Hyrtl.³ The large branch of the accessory pharyngeal artery to the lower and anterior part of the middle constrictor seems unusual; a laryngeal branch of the ascending pharyngeal is mentioned by Hildebrandt.³ The internal pterygoid branch of the accessory pharyngeal artery above noted seems of interest.

The middle meningeal has been seen to give off an artery to the tongue, which divided into sublingual and dorsal lingual.³ The origin of a palatine artery from the middle meningeal is unusual, and if taken in connection with the fact that a branch of considerable size enters the body of the sphenoid, would seem of more than ordinary interest. That branches of the pharyngeal arteries should supply the sphenoid bone is to be expected; and from the known facts with reference to the development of the pituitary body, and the connection of the anterior part with the pharynx at one period, the arterial supply of the continuous structure is probably derived from the same source when the anterior part is united with the pharynx. As the body of the sphenoid becomes filled up, the connection of the hypophysis (anterior lobe) with the pharynx becomes narrower, and finally the parts are separated, the former joining the infundibulum. The vascular supply from the pharyngeal source ceases partially or entirely, and becomes replaced in part or altogether by an intracranial supply. In one case recorded by W. Müller,⁴ an artery (presumably) from the pharyngeal was found coming from the body of the sphenoid and entering the pituitary body. A foramen cavernosum ossis sphenoidi for the vena vertebralis mediana is present in the rabbit (W. Krause).⁵ The palatine artery described above may be supposed to represent an original palato-maxillary artery, and supply the process of that name, the pharynx and the hypophysis. The change that resulted from the further development of the parts left the major portion of the artery supplying the palate and the pharynx, whilst another portion, viz., that which supplied the hypophysis, remained as a branch entering the body of the sphenoid.

¹ *Arteries*, p. 110 (8 cases in 144).

² Hildebrandt's *Anatomic*, vol. iii. 361.

³ W. Krause, in Henle's *Handbuch der Gefäßlehre*, p. 251.

⁴ *Jenaische Zeitschrift*, 1871, referred to by Henle, *op. cit.* p. 251.

⁵ *Allgemeine und microscopische Anatomie*, p. 437.

RESPIRATORY EXCITATION

AND

DEPRESSION.

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RESPIRATORY EXCITATION AND DEPRESSION.^a

AUTOMATIC respiratory actions have their origin in the medulla and spinal cord. In the former the respiratory bundle is a cord 1 mm. in thickness, which consists of varicose nerve fibres, and is united at its origin with the nucleus of the vagus. This cord receives fibres from the glosso-pharyngeal vagus and spinal accessory, and is connected also with the hypoglossal. In the middle and lower part of the medulla the bundle divides into parallel branches, and these appear to stand in relation with the phrenic nerve. In the dorsal and upper part of the lumbar region the posterior vesicular column, which consists of ganglion cells and nerve fibres, and is most sharply and distinctly limited in the position of the lower dorsal and upper lumbar nerves, establishes a connexion between certain fibres of the posterior roots and other parts of the spinal cord of the same side. In continuous connexion with this nucleus are scattered masses of cells in the cervical and sacral regions of the spinal cord. In the spinal cord the respiratory bundle is a longitudinal cord of fibres, which may be traced upwards to the medulla oblongata. Nerve fibres pass upwards to the higher nerve centres that establish a connexion between this and the respiratory centre.^b Thus respiratory centres exist in the medulla and spinal cord, capable not only of propagating but of reflecting stimuli. The principal respiratory centre is situated near the calamus scriptorius.^c

Nerve fibres that serve for different respiratory purposes are connected with the medulla oblongata and spinal cord; motor nerves, that act on the muscles of inspiration and respiration; and sensory nerves, that transfer stimuli from distant parts to the respiratory centres, and ultimately to the muscles concerned in the respiratory acts. The vagi are distributed to the muscular structures found in the trachea (at the extremities of the rings and between the rings),^d bronchi, and lungs, and the

^a Read before the Ulster Medical Society, April, 1879.

^b Krause. *Allgemeine und microscopische Anatomie.* Pp. 391, 392, 412.

^c Longet. *Traité de Physiologie.*

^d Ludwig. *Lehrbuch der Physiologie des Menschen.*

same nerves contain different fibres that are destined for the mucous membrane of the air-passages.

The lung substance and certain respiratory muscles are supplied with ganglia, which confer upon them a certain degree of independent action. Kölliker^a found ganglia in the lung substance—a fact that has been confirmed by other observers; and in connexion with the distribution of the right phrenic nerve Luschka^b pointed out the existence of the phrenic ganglion. The experiments of Brown-Séquard with reference to the rhythmical contractions of the diaphragm and other muscles showed that these ganglia are not without their use.^c

The connexion that exists between the terminations of sensory nerves distributed to the air-passages and to various other parts of the body with the motor apparatus of the chest and abdomen causes the latter to respond to stimuli applied to the former, and section of nerves by which the centres are deprived of existing stimuli produces a change in the character of the respiration.

The effect of cold applied to the external surface in adults and children is an often-mentioned illustration of the effect of a stimulus applied to the peripheral extremities of sensory nerves, and irritation of the peripheral endings of the fifth and other nerves in the air-passages is sufficiently conclusive. The excitation of a sensory nerve was shown by Schiff to produce an increase in the number of respirations, provided such stimulus be moderate. If, however, the stimulus be strong, a diminution takes place, and inspiration tetanus may result.

Division of the vagi increases the depth and diminishes the number of the respirations (Fig. 1), whilst stimulation of the central cut extremity increases the number, and, if strong, will give rise to inspiration tetanus; the rhythmically active agents in expiration in this case become quiescent. The power of a reflex stimulus was found to affect the muscles of inspiration in the same order as increasing dyspnœa—viz., the diaphragm, the external intercostals, the intercartilaginous muscles, levatores costarum, scaleni, and serratus posticus (Traube).^d The agents that were rhythmically contractile before became quiescent during the stimulation.

Stimulation of the superior laryngeal nerve, if moderate, diminishes the number of the respirations; if strong, it produces expiration tetanus. Thus, in one of Rosenthal's experiments, with a moderate current (coils 200 mm. distant), the diaphragm was quiescent, the thorax remained in the position of rest, no muscle contracted, and the thyroid cartilage moved quickly up and down. With a stronger stimulation (coils 160 mm. dis-

^a *Microscopische Anatomie.*

^b *Anatomie des Menschen.* I., 2, 218.

^c *Jrl. d. l. Physiologie.* Tome II., p. 115.

^d Rosenthal. *Die Athembewegungen u. ihre Beziehungen zum Nervus Vagus*, p. 182.

tant) there was quiescence of the diaphragm, tetanic contraction of the abdominal muscles, great diminution of the thoracic cavity, and depression of the ribs.^a The action of the superior laryngeal nerve is thus comparable to the action of the splanchnic on the intestines and the vagus on the heart, with this difference, that the centres on which these nerves act are situated in the organs themselves, whilst in the case of the former nerve the centre is situated in the medulla oblongata. (The researches of Legallois and Flourens showed that the centre for the diaphragm was situated in the medulla.) The fact that stimulation of the superior laryngeal nerve produces inhibition of the diaphragm by its action on the nervous centre in the medulla confirm the opinion of Ludwig and Weber that the two nerves above referred to produce inhibition by acting on nerve cells situated in the organs to which they are distributed.^b

The connexion of the respiratory centres with the higher parts of the nervous system ensures a certain amount of controlling power. By the will the number of respirations can be increased or diminished, and the respirations are influenced by the degree of activity of the cerebrum. The effect of close attention upon respiration is an often-mentioned illustration of this fact.

Certain changes in the blood produce very marked effects upon the respiratory actions. The blood so altered may cause these changes by its action upon the respiratory centres or upon the peripheral terminations of nerves connected directly or indirectly with them.

The effect of the introduction of certain substances into the blood is well known. Atropia, for example, when given in small doses, increases the number of the respirations—in large doses it diminishes. Opium retards, and its action is distinct after section of the vagi.^c Strychnia increases the number and depth, and phenic acid causes the respirations to become, first, rapid and regular, and then rapid and feeble.^d

The effect of morbid poisons has only to be mentioned.

An increase or diminution of oxygen in the blood gives rise to phenomena which are due to an increased or diminished stimulus to the nerve centres, which may take place as the direct effect of an increased or diminished stimulus, or indirectly by the increased or diminished oxidation of certain products in the blood.^e An increased amount of carbonic acid acts as a powerful stimulus to the respiratory centre.

Dyspnœa can be produced in an animal by causing it to breathe nitrogen or carbonic acid (70 O to 30CO₂). In the former the quantity

^a Rosenthal. *Op. cit.*, 229.

^b *Comptes rendus*. 1861. 755.

^c Köller. *Handbuch der physiologischen Therapeutik und Materia Medica*. Pp. 1004 and 1072.

^d Bert. *Leçons sur la Physiologie comparée de la respiration*. 416.

^e Ludwig and Schmidt. *Berichte d. Gesell. der Wissenschaften zu Leipzig*. 1867.

of oxygen in the blood is greatly diminished, the quantity of carbonic acid being little affected; in the latter the carbonic acid is greatly increased, whilst the oxygen Pflüger found in some experiments increased.^a

Dyspnœa can be produced by opening the thoracic cavity and puncturing the lung over the surface; if oxygen or air be forced into the lung through the trachea the dyspnœa disappears, and will reappear if carbonic acid or nitrogen be substituted for the former gases (Traube). It can also be induced by fitting a stop-cork to a trachea canula and diminishing the aperture.^b

The following method, adopted by Dr. von Kries and myself in our experiments in Professor Ludwig's laboratory, has this advantage, that the resistances in different experiments can be easily ascertained and compared. A trachea canula was fitted to Müller's bottles;^c the dyspnœa was produced by lowering the tube in the mercury of the inspiration bottle. Some of the results are shown in the following table:—

TABLE I.

Time	Number of respirations in five seconds	Temperature	Resistance in millimetres	Duration of resistance
H. M. S.		°		Seconds
4 17 0	·45	38·2	0	—
4 22 0	·5	38·6	0	—
4 24 0	1·1	38·6	5	35
4 24 35	·7	38·6	0	—
4 24 0	1·0	38·6	5	35
4 26 30	1·	38·6	0	—
4 27 0	·5	38·6	0	—
4 29 30	·8	38·6	2	103
4 31 0	1·5	38·6	0	—
4 32 0	4·4	38·6	0	—
4 33 0	1·	38·4	2	150
4 36 0	1·	38·4	0	—
4 37 0	·55	38·4	0	—
4 43 0	·833	38·4	2	150

^a Pflüger. Archiv. Band I., p. 92, et seq.

^b Cyon. Methodik der physiologischen Experimente und Vivisection. P. 253.

^c Annalen der Chemie und Pharmacie. B. 108, p. 257.

In another experiment, with a resistance of 0 mm. of mercury, the number of respirations was 6 per minute; with a resistance of 5 mm. the number was increased to 13·2 per minute; and with a resistance of 2 mm. the number of respirations was 10 per minute. The vagi were cut at the beginning of the experiments. Bert has made numerous experiments with reference to the effects of obstruction. They will be found in his book on Respiration.^a

Dyspnœa and asphyxia can be produced by supplying an animal with air or oxygen which contains ozone. The effects of a change in the condition of the oxygen inhaled have been studied by Professor Redfern, Dr. Barlow of Glasgow, Dr. Richardson, and others. Dr. Redfern made use of mice in many of his experiments. The ozone was prepared by electrolysis, and, after being purified, was passed into the chamber containing the animal. A mouse (in Experiment XI.), weighing 50 grains, was placed in the chamber containing oxygen and ozone, at 4 33 p.m.; in half a minute the eyes were closed; in a minute the head was elevated during inspiration. At 4 35 the mouse was removed, and exposed to a current of air, but no improvement took place. At 5 15 the animal is still breathing almost imperceptibly; eyes closed; can walk a few paces when disturbed. At 10 10 the animal, which has remained quiet since last report, and whose respirations have been regular (87 per minute) during the greater part of the time, is attacked now with dyspnœa. The animal died at 10 30 p.m. The right side of the heart was found gorged with blood; the left side was empty.

In order to determine whether the dyspnœa was due to closure of the glottis, an opening was made in the trachea. The animal (in Experiment XIV.) was then introduced into the chamber; in $2\frac{1}{2}$ minutes the mouse fell over on its side, and in $3\frac{1}{2}$ minutes died.

In Experiment VIII. the mouse commenced to inhale the ozone at 12 27; at 12 52 the mouse moved about uneasily, and rubbed its nose; at 12 58 convulsions and death. It will thus be seen that death resulted from asphyxia, the heart in this case also being gorged with venous blood. The experiments of the same observer on rabbits, frogs, insects, and worms, were attended with similar results. These experiments have been confirmed by the observations of Dr. Barlow,^b who considers the asphyxia to be due to an alteration of the lining of the air-cells by the ozone.

In the experiments recorded above, the amount of ozone present was about the $\frac{1}{240}$ th part, the remainder being oxygen; so that oxygen, in the form of ozone, is a very powerful agent in the production of dyspnœa.

Dyspnœa produced by heat is of interest to the physician and physiologist.

^a Op. cit., p. 408.

^b Journal of Anatomy and Physiology. Vol. XIV., Part I.

If an animal is introduced into a hot-air bath, and the temperature so regulated as to produce an increase in the temperature of the animal (the temperature is determined by means of a thermometer placed in the vagina or rectum), when such an increase is sufficiently great, the respirations increase in number, and diminish in depth.

The respirations can be registered in various ways. The apparatus of Marey^a and Bert^b are described in their works; many other methods are given by Cyon.^c A very convenient method is the following:—A small bag connected with a glass tube is introduced into the œsophagus, and passed down to the thorax to within a short distance of the œsophageal opening of the stomach; the other end of the tube is connected with a Marey's tambour; the bag is dilated with water, introduced by means of a syringe after the bag has been passed down to the thorax. An alteration in the capacity of the thorax causes a movement of the lever of the tambour, so that the respirations can be easily registered. Table II. gives the results of an increased temperature upon the respirations of a dog (Figs. 3 and 4).

TABLE II.

(The temperature and the number of respirations in five seconds are given.)

Temperature	Respirations in five seconds	Temperature	Respirations in five seconds	Temperature	Respirations in five seconds
° 39·8	3·5	° 40·5	3·0	° 41·1	11·9
39·9	3·7	40·6	3·7	41·2	6·4
40·0	3·7	40·7	4·9	41·3	5·4
40·1	3·5	40·8	4·8	41·4	7·9
40·2	3·3	40·9	4·5	41·5	8·2
40·3	2·6	41·0	7·4	41·6	7·3

The table confirms the results of Ackermann and Goldstein.^d A reference to the table and plate will show that two very important changes take place in the respirations—viz., an increase in frequency and a diminution in depth; and whilst the former is generally characteristic of dyspnœa, the latter is present in a different condition, to which I shall hereafter refer.

^a La Méthode Graphique dans les Sciences Expérimentales, p. 541.

^b Bert. Op. cit., p. 209.

^c Op. cit., p. 208, et seq.

^d Ueber Wärmeddysnoe. Inaugural Abhandlung. 1871.

The dyspnœa so produced is referable to one of the following causes—direct stimulation of the respirations without a corresponding stimulation of the inhibitory centres, or a weakening of the latter without affecting the former. In the former case, the centre itself, the peripheral extremities of afferent nerves, or the cerebrum, are the parts to which the stimulus is applied; in the latter, the respiratory inhibitory agents are the parts affected. If the increase of temperature acts only on the inhibitory centres, then the excitor nerves would either produce apnœa by their own action, or assist artificial respiration in producing it in case complete oxygenation be sufficient for that purpose. Ackermann and Goldstein have shown, however, that apnœa cannot be produced by artificial respiration when an animal suffers from heat dyspnœa, and this although the blood contained in the veins became bright red during the experiment—hence the stimulus must be due, in part at least, to the direct or indirect stimulation of the excitor centres. That heat dyspnœa is not due to the presence of venous blood alone, the experiments of Ackermann and Goldstein show; that it is almost entirely due to the increased temperature, our experiments seem to prove, as artificial respiration altered but little the character of the respirations.

The stimulus may be applied to the respiratory centre directly or indirectly, as already mentioned. Goldstein's experiments show that the dyspnœa is not produced by the action of the heat upon the peripheral extremities of the sensory nerves, on the peripheral extremities of the vagus, or the higher sense organs. Cold applications to the surface, cutting the vagi, and the administration of narcotics, did not affect the results. Heating the carotid in a water bath was found sufficient to produce heat dyspnœa.

The amount of air breathed during this form of dyspnœa seems to be greatly augmented. Several methods may be used in an investigation of this kind. Müller's bottles may be employed with water or mercury, or Czermak's lever^a applied to the chest, and connected with an electromagnetic arrangement which alternately opens and shuts the inspiratory and expiratory tubes. For the determination of the gases, Regnault and Reiset's modification of Lavoisier's apparatus is the most accurate.^b

The respiratory movements of an animal cease under certain circumstances, and this though the heart beats as before, and the actions of the body remain unaltered. This condition was named apnœa by Rosenthal. Hook, in 1667, opened the chest of a dog before the Royal Society, and by means of a bellows forced air into the lung, which escaped by punctures made over their surface. He found that "the eyes were all the

^a *Gesammelte Schriften*, p. 820.

^b *Recherches Chimiques sur la Respiration des Animaux*. *Annales de Chimie*, 3rd Series, 299. T. XXVI. For a description and figure of Lavoisier's apparatus see Jamin, *Cours de Physique*. T. II., p. 494.

time very bright," and the heart beating regularly; there was no respiratory movement ^a (Sanderson).

Apnœa can be induced by forcing air into the lung by a series of blasts (60 or more in the minute). The air escapes from the chest after each insufflation, by an aperture in the canula.

The duration of the apnœa is influenced by the duration of the artificial respiration that has preceded it.

I have frequently obtained apnœa for 15 seconds in dogs by employing artificial respiration for one minute, and apnœa for 25–30 seconds by artificial respiration of two minutes' duration. By prolonged artificial respiration, however, apnœa may be obtained for two minutes (Cyon,^b Pflüger^c), or even for five minutes (Rosenthal). Ewald, by artificial respiration for half an hour in a dog, obtained apnœa for half a minute to a minute and a half. This was followed by one or two superficial inspiratory actions, which were succeeded by a pause; after ten minutes normal respiration was established.

In considering the causes of apnœa, it is necessary to take account of the condition of the blood during the cessation of respiration, and the nature and action of the force employed. Ewald found that the oxygen in the blood was slightly increased, and the carbonic acid distinctly diminished.^d In one of his experiments (Versuch 4, Serie II.) the arterial blood was a brighter red during apnœa than before it. Pflüger found that the amount of oxygen taken up during artificial respiration was sometimes greater and sometimes less than normal—the amount of carbonic acid given out greater. Finkler and Oertmann showed that the amount of oxygen in the blood depends on the force used—anything that diminished rapidly the circulation diminishes the oxygen—and that whilst at the beginning the amount of oxygen taken up is apparently less, and the amount of carbonic acid given out is greater, the reverse held after the cessation of the artificial respiration. They further showed that the colour of the venous blood depends on the character of the artificial respiration and the energy of the heart's action.^e The respiratory centres thus lose any stimulus due to the diminution of oxygen or the increase of carbonic acid; quiescence in the active respiratory agents is the result.

It is necessary to take a glance at the effects produced in an animal by breathing pure oxygen. Several observers have directed their attention to this subject. Professor Redfern prepared pure oxygen from peroxide of manganese. The gas was purified by means of lime-water

^a Handbook for the Physiological Laboratory. P. 318.

^b Op. cit., p. 256.

^c Archiv. B. I., p. 256.

^d Inaugural Dissertation, 1873; and Pflüger's Archiv. 1873. P. 575.

^e Pflüger's Archiv. 1877.

and caustic potash, and passed into a large receiver, placed over lime-water; into this receiver a jet of lime-water kept constantly playing. Two mice were introduced into the atmosphere of oxygen (Experiment XIX.), and were confined in a wire cage, and supplied with food. The receiver was perfectly free from carbonic acid during the whole experiment, and the amount of the latter gas was estimated from time to time, and noted. During the whole time the mice remained remarkably tranquil, and no remarkable difference was observed in the character of the respirations.

The amount of oxygen absorbed when air is breathed is placed by Pflüger at nine-tenths of the amount absorbed when oxygen is breathed. Gréhant^a found, however, the amount very much greater in the latter case, and considers the increase, $\frac{1}{26}$ th, due to the rapidity of the circulation and activity of the respiratory movements, which cause a frequent renewal. It must be remembered, however, that frequent renewals of the air in artificial respiration is attended with a diminution of the carbonic acid contained in the blood and in the air-cells; and thus the stimulus is diminished. It is well known that if, by the power of the will, the number of normal inspirations be increased, the amount of carbonic acid expired is increased. Czermak points to this fact in connexion with Rosenthal's experiments. He says:—"If in tranquil respiration I make 3-4 respirations in 15 seconds, and interrupt the breathing by a final deep inspiration, I succeed in keeping my breath for 30-35 seconds, then, however, the respiratory necessity forces me to continue respiration. If, on the other hand, I make 15-18 complete respirations in 15 seconds, and again interrupt my breathing with a similar deep inspiration, I am enabled to retain my breath for another half minute or minute before I am forced by the same degree of respiratory need to resume my respiration." ^b

The amount of oxygen absorbed by the blood varies, according to the experiments of M. Gréhant, in different apparently healthy animals of the same species (thus the volume per cent. that could be absorbed he found in one case 18·8, and in another 31·3), and is proportional to the amount of hæmoglobin in the blood.

The experiments of von Lesser, performed in the Leipzig laboratory, show that many circumstances affect the amount of hæmoglobin in the blood. The amount of hæmoglobin in the large arteries and large veins, at the same time and under the same circumstances, is the same. A variation in the rapidity of the flow of blood in the arteries, due to increase in the peripheral resistance or variation in the number of heart beats, produces no change. The amount of hæmoglobin in the blood-current is dependent on such variations in tension in the arterial system

^a Gréhant. *Comptes Rendus*. T. LXXV., p. 496.

^b *Centralblatt f. d. Wissenschaft.*, 1866; and *Gesammelte Schriften*, p. 767.

as serve to diminish or increase quantitatively the flow of blood to the right heart. This observer has shown that the abstraction of blood, provided that it does not exceed a certain amount, does not diminish the amount of hæmoglobin. Tying an animal in the recumbent position, produces a transitional increase and decrease. The cutting and stimulation of the spinal cord affects the amount of hæmoglobin in so far as it affects the flow of blood to the right heart. Tying the portal vein is attended with a diminution in the amount of hæmoglobin in the arterial system; this diminution takes place with a variable degree of rapidity depending on the vascular connexions of the vena portæ. The diminution is apparently more rapid than the sinking of the arterial pressure. Interruption of the circulation in the lower extremity is attended with somewhat variable results.^a

These experiments prove that the number of corpuscles in the arterial and venous system is subject to variation, and that it is dependent upon such a variation in the tension of the vascular system as increases or diminishes the flow of blood to the right heart; and this tension is, within certain limits, under the control of the nervous system.

In making an estimation, therefore, of the amount of oxygen contained in the blood under different circumstances, it is necessary to take account of the amount of hæmoglobin contained in the blood-stream. Thus, if the number of blood-corpuscles in any part of the system be increased, more oxygen, *cæteris paribus*, will be found in that part of the system, and if less blood-corpuscles, then less oxygen will be present. An alteration in the relation of the blood-corpuscles to the capillary walls is regarded by some as a result of deficient oxygenation. In this respect their condition is, to some extent, comparable to the relative conditions of the blood and blood-vessels in inflammation. In the latter, in the second stage, a massing of the red blood-discs takes place in the capillaries. This phenomenon, which was regarded by Lister to be of the same nature as the formation of *rouleaux* in blood that is drawn, has been shown by other observers to depend, in part or altogether, on an alteration in the capillary walls.^b

A change in the distribution of the blood-corpuscles in the state of asphyxia, which would be attended with the withdrawal of an appreciable number of blood-discs from the larger arteries and veins, would necessarily, other things being the same, lead to a diminution in the amount of oxygen in the larger veins and arteries. An estimation of the amount of oxygen in the larger arteries and veins would, in that case, require correction before it could be taken as a sign of the oxygenation of the general mass of blood. In the condition of apnœa, on the contrary, the diminution in

^a Ueber die Vertheilung der rothen Blutscheiben im Blutstrom. Reichert und Du Bois Reymond's Archiv. Phys. Abth. 1878.

^b Dr. Sanderson, in Holmes' Surgery. Vol. V, p. 757.

the amount of the carbonic acid in the blood produces necessarily an alteration in the relation of the blood to the capillaries. If such an alteration be attended with a withdrawal of the blood-discs from the capillaries and an increase of these elements in the larger arteries, then the amount of oxygen, as given by an analysis of the blood in the larger vessels, is too high, if it be taken as a sign of the oxygenation of the general mass of the blood. Pflüger has shown that the colour of the blood depends on the number of corpuscles present, as well as the gas contents.^a The venous blood in apnœa is frequently dark in colour—a circumstance attributed by Finkler and Oertmann^b to the character of the artificial respiration and the nature of the heart's action. They showed that if the animal be placed in a warm bath the venous blood becomes red. This may be accounted for in two ways. The effect of the warm bath is to cause dilatation of the capillaries, and the blood that passes into the veins has more oxygen, and the heart's action is at the same time increased by the heat (Finkler and Oertmann); or the change in the colour of the blood, from dark red to bright red, may be accounted for by supposing the heat to produce such alteration in the walls of the capillaries as leads to a dilatation of these vessels and an accumulation of red blood-corpuscles in them. In this case the number of blood-discs in the larger vessels would be reduced, and a brightening in the colour would result—so that if such an alteration in the general distribution of the red blood-corpuscles takes place in asphyxia and apnœa, the number of oxygen carriers in the larger vessels in the former case is diminished, and in the latter increased, whilst the total number in the blood may be unaltered.

The velocity of various fluids through capillary tubes must be regarded as an important element in the determination of the general condition of the blood, from an analysis of a portion of blood taken from a large vein or artery during the condition of apnœa or asphyxia.^c

It is necessary to take a glance at the mechanical means used to produce apnœa. Artificial respiration differs from ordinary respiration in this way, that in the former the air is used to force out the lungs and chest walls, and in the latter the expansion of the chest and lungs draws in the air. The force used in drawing air into the lungs, and which acts upon the various tissues in the air passages and chest walls, produces the simple mechanical effects of pressure upon the terminations of nerves in their structures, or by expanding the muscular and elastic tissues of which the lungs and parietes are composed, alters the condition of the nerves supplied to these structures. The state of expansion of the chest walls and lungs acts as a stimulus to the expiratory (inhibitory) nerves of respiration, and the state of contraction acts as a stimulus to the inspiratory

^a Archiv. B. I.

^b Op. cit.

^c Annales de Chimie. III., XXI., 76.

nerves^a (Hering and Langendorff). The effect of artificial respiration is to stimulate the nerves distributed to chest walls, diaphragm, and air-passages, so as to produce an inhibitory action, and in this way the active inspiratory agents become quiescent. The experiments of Brown-Séquard, made with a view to determine the cause of the arrest of strychnia tetanus under certain circumstances, support this theory. Brown-Séquard confirmed the observations of Rosenthal and Leube, that insufflation arrests strychnia tetanus, but differs from these observers with regard to the cause. Rosenthal considered the arrest to be due to the increase of the oxygen in the blood. Brown-Séquard found that the mechanical effect of insufflation upon the terminations of the vagi and the nerves of the diaphragm was the cause of the cessation of the tetanic spasms, since insufflation was without effect after division of the vagi and section of the spinal cord above and below the origin of the phrenic nerves.^b Thus it is seen that insufflation has a distinct inhibitory effect upon muscular contraction, and this by the stimulation of the terminations of the nerves supplied to the air-passages and diaphragm.

The respiratory centres then can be excited in many ways. Oxygen diminishes, carbonic acid excites, respiratory action. As the oxygen is carried to the respiratory centres by the blood-discs, the fewer the number of blood-corpuscles that travel to the medulla, and the less oxygen they contain, the respiratory centre receives the greater stimulus. Increase in the amount of oxygen in the blood-corpuscles and increase in their velocity will compensate for a diminished number. An increased velocity can be obtained by an increased action of the heart, and an increase of oxygen by more perfect aëration.

Artificial respiration acts in two ways upon the nerve-centres. The carbonic acid contained in the blood and air-passages is diminished, so that the nerve-centres lose the stimulus due to the action of carbonic acid on the respiratory centres; secondly, the pressure of the air forced into the lungs upon the nerve terminations in the bronchi, &c., produces an inhibitory effect upon certain respiratory structures.

EXPLANATION OF PLATE.

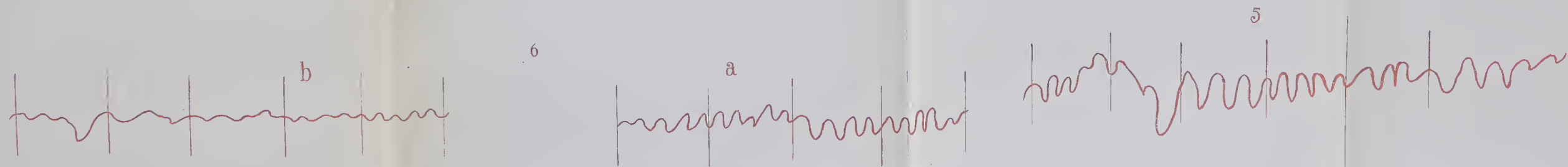
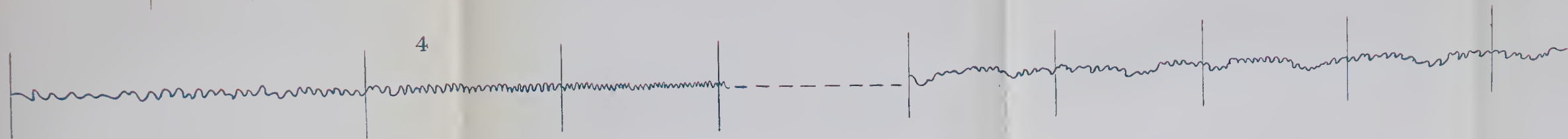
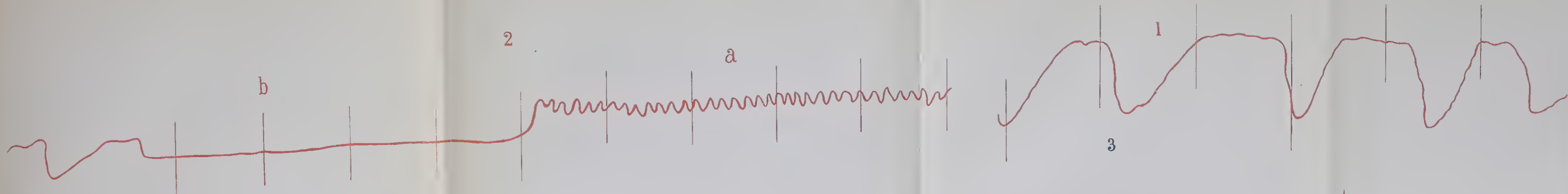
Fig.

1. Respiration curve after cutting of the vagus.
2. *a.* Artificial respiration. } Tracing continuous with, and subsequent to, Fig. 1.
- b.* Apnoea.
3. Respiration curve, vagus cut, with pulse waves.
4. Same tracing (heat dyspnoea).
5. Respiration curve before resistance.
6. *a.* During resistance.
- b.* After resistance.
7. *a.* } Respiration curves.
- b.* }

N.B.—In Figs. 1 to 6 the vertical lines mark intervals of 5 seconds. In 7 and 8 the tracing of a time-marker indicating seconds is shown.

^a Du Bois Reymond's Archiv. 1879.

^b Ringer. Therapeutics. P. 561.



N O T E

ON

APNŒA AND HEAT DYSPNŒA.

BY

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N O T E

ON

APNŒA AND HEAT DYSPNŒA.

DURING the Winter Session, 1879-80, a paper was read by me at the Ulster Medical Society, entitled "Respiratory Excitation and Depression." Some points of importance bearing on the history, nature, and cause of apnœa and heat dyspnœa have since come to my knowledge, and I shall here briefly state them.

APNŒA.

As far back as 1858 Professor Brown-Séquard showed that pressure on the head of an animal affected the character of the respirations. The respirations are slowed by pressure upon the head. Subsequently the same physiologist found that injection of carbonic acid, nitrogen, and other gases with force into the laryngeal side of a tracheal opening produced apnœa; the same phenomenon appeared, but in a less degree, when the injection was made into the pulmonary side. The result of the experiments was doubted by Filehne, but his mistake arose from the fact that he did not carry out the details of the experiments.

Some experiments that have a very important bearing upon the cause of apnœa were made by Professor Brown-Séquard a considerable time ago; and during last winter and the present summer not only have the results been confirmed, but many important facts have been added thereto. The experiments were made principally on dogs and rabbits.

If a dog be fixed in the usual position on Bernard's dog-board, the trachea opened, and a canula introduced for the purposes of artificial respiration if necessary, but more especially with the

object of obtaining the respiratory tracings on a rotating cylinder, and the head be pressed upon, the respirations immediately change in character—in fact, they become slower. If, however, the head be bent strongly forwards, complete cessation of the respirations as a rule results—in other cases, when a prolongation of the pause is observed, in a greater or less degree. The season of the year seems to have some influence on the result; for with rabbits, in the winter apnœa was much more prolonged than in the summer months. Division of the pneumogastric nerves does not affect the comparative results. When, however, the cerebrum is removed, no apnœa is produced by flexion of the head. When the lateral half of the medulla is divided the apnœa is less marked than when that structure is entire. It thus follows that the tension of the medulla oblongata produced by the forcible flexion of the head is the cause of the apnœa.

It has been stated by some that the veins contain red blood in apnœa, but the colour of the blood varies according to the conditions under which apnœa is produced. In the experiments performed in the College of France the blood of the veins was distinctly redder, approaching the colour of arterial blood. Another fact of interest is that the temperature of the rectum is lowered by depression of the head.

In experiments of this kind it is of the utmost importance that the trachea tube should be quite free, that no structures be injured which will produce convulsions or affect the character of the respirations unless in such a way as may be desired. The asphyxia superinduced by accidents of this kind will necessarily affect the result, but this occurs so rarely with care that it is sufficient to mention it.^a

HEAT DYSPNŒA.

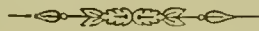
A paper appeared in the September (1879) number of the *Journal of Physiology* which contains some important facts with reference to heat dyspnœa. It is there shown that the experiments of Goldstein and Ackermann, though accurate, are susceptible of an explanation very different from that given by these observers. Dr. Sihler points out that the method of warming the blood adopted by Goldstein and Ackermann is imperfect, that the bath

^a Paper read before the Société de Biologie, July 3, 1880. Archives of Scientific and Practical Medicine, p. 87. Prolongation extraordinaire des principaux actes de la vie après la cessation de la respiration. Archives de Physiologie. 1878.

introduced into the wound increases the number of the respirations when the carotid is tied, and that hot water brought into contact with wounds in the thighs increases the frequency of the respirations. The same observer has found that section of the spinal cord at the lower part of the neck diminishes the power of heat in producing an increase in the number of the respirations, and enables artificial respiration to produce apnœa when the blood is heated. He concludes that warmed blood and skin stimulation are factors, the latter the more important, in the production of heat dyspnœa. The same observer regards the venosity of the blood as the sole or principal cause of the action of the nerve centres.



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Ueber secundäre Wirkung vom Herzen auf Muskeln.

Von

Dr. **R. J. Anderson** aus Belfast.

Um die Erregung eines Muskels durch das schlagende Herz zu zeigen, habe ich außer den Herzen des Kaninchens, des Frosches und der Schildkröte, von welchen Professor *Kühne* die secundäre Wirkung auf den angelegten *M. sartorius* des Frosches erhalten hatte, die Herzen einiger andrer Thiere geprüft und dem Experimente eine Form zu geben versucht, welche möglichste scharfe und anhaltende Beobachtungen gestattete. Unter den leicht zu erreichenden Thierherzen fand ich das der Kröte (*Bufo vulgaris*) geeigneter, als das des Frosches und fast so wirksam, wie das Schildkrötenherz, noch besser das Säugethierherz (vom Kaninchen), wenn es nach dem Herausnehmen länger schlagend erhalten wurde.

Die vom Krötenherzen zu beschreibenden Versuche gelingen auch am Froschherzen und sowol mit curarisirten, wie mit un- vergifteten Muskeln; vom Krötenherzen waren die Wirkungen nur häufiger und der curarisirte Sartorius pflegte kräftiger zu zucken. Von jeder Stelle des Herzens war der Muskel zum Zucken zu bringen, sowol vom Ventrikel, als von den Vorhöfen, auch nach der Trennung dieser von einander; die Wirkung der letzteren war jedoch seltener und schwächer. Der Muskel reagirt am besten bei direkter Berührung, vielfach gelang es aber auch die Wirkung durch unpolarisirbare, auf zwei Punkte des Herzens gesetzte Electroden zu übertragen, indem man die metallischen

Enden der Leitung mit einer 2—4 mm langen Muskelstrecke überbrückte.

Da der direkt angelegte, an einem Ende befestigte, hängende Sartorius durch das schlagende Herz passiv mitbewegt wird, ist die secundäre Zuckung nur durch die Art der Bewegung und durch das Eintreten vor der Formänderung des Herzens zu erkennen. Ueber beides können unter Umständen Zweifel entstehen: die vorangehende Systole der Vorhöfe kann das ganze Herz verschieben oder ausdehnen, wenn sie Blut in den Ventrikel treibt und der Muskel kann zur Zeit der Ventrikelsystole so gehoben werden, daß er sich zu falten oder zu krümmen beginnt, wie er es mit aufliegendem Ende auch thut nach Ablauf einer Zuckung. Ist die secundäre Zuckung kräftig, so entstehen zwar solche Zweifel nicht, schon weil der Muskel nicht selten emporschnellt und sich ganz vom Herzen loslöst, oder weil seine Verdickung und Verkürzung von anderen Bewegungen unmittelbar zu unterscheiden sind; dagegen werden schwächere Zuckungen leicht übersehen. Ein brauchbares Verfahren, diese Zuckungen zu erkennen, bestand darin, das Herz auf eine horizontal vorstehende Papierzunge zu legen, deren Spitze sich nach abwärts bog, wenn der Ventrikel sich im Schlage verdickte und gegen den darüber fixirten M. sartorius stemmte. Am Kymographion schrieb die Papierspitze jede Systole als Curve unter die Abscisse, unmittelbar vor jeder Curve aber eine Erhebung über die Abscisse, falls der Muskel präsysstolisch gezuckt und das Herz, an dem sein unteres Ende klebte, sammt dem adhären den Papierstreifen emporgehoben hatte. Ein anderes Mittel die secundäre Wirkung gut sichtbar zu machen, bestand in der Erregung tertiärer Zuckung eines Froschschenkels, dessen Nerv in einiger Entfernung vom Herzen schräg über die fascienfreie Fläche des Sartorius gelegt war. Das Verfahren schlug zwar nur bei kräftigeren secundären Zuckungen an, war aber sehr bequem für Versuche am Säugethierherzen im Leben, wo

man den Sartorius tief in den eröffneten Thorax senken muß, und die respiratorischen Bewegungen, das Auf- und Abgehen der Lungen, sowie das Schleudern des Herzens nach Eröffnung des Pericardiums der Beobachtung hinderlich sind.

Obgleich die secundären Zuckungen vom schlagenden Kaninchenherzen während künstlicher Respiration fast maximal scheinen, und etwa so lange anhalten, als der Muskel von der Erwärmung und Befeuchtung nicht leidet, wollte es nicht gelingen die electriche Wirkung durch unpolarisirbare Electroden nach außen zu übertragen. Weder beim Kaninchen noch beim Hunde war mittelst der Leitungsdrähte ein *M. sartorius* zu erregen, selten sogar ein hoch erregbarer *N. ischiadicus*, auf welche Stellen des Herzens die Thonspitzen aufgesetzt sein mochten. Ebenso erfolglos war das Anlegen einer Electrode auf die verschiedensten Punkte der Herzoberfläche, während die andere in Gestalt einer langen, mit Ausnahme des amalgamirten Endes, lackirten Zinkstange von der *Art. carotis* her, nach Forcirung der Aortenklappen in's Innere des Herzens gesteckt war. Wie es scheint sind die Nebenschließungen durch die Brusteingeweide das Hinderniß, gegen das indeß auch das Aufbetten des Herzens auf Kautschukstreifen nicht half.

Die secundäre Wirkung auf einen andern Muskel lehrt, daß die Herzmuskulatur entweder durch besonders kräftige Actionsströme oder durch electriche Vorgänge ausgezeichnet ist, deren zeitlicher Verlauf geeigneter zu direkter Muskelreizung ist, als die des gestreiften Muskelgewebes im Allgemeinen. Man konnte daran denken, daß diese Ströme im Stande seien, eine ganze Reihe physiologischer Effecte auszuüben, die von andern Muskeln niemals erhalten sind, z. B. Erregungen größerer entnervter Muskeln, oder eines andern Herzens, unter Umständen benachbarter Theile desselben Herzens und vielleicht von Sinnesnerven, auch des Menschen. Einen Versuch, der Professor *Kühne* einmal

mit dem Herzen des Hundes¹⁾, öfter an dem des Huhns geglückt war, nämlich dem am Myographien befestigten curarisirten Froschgastrocnemius die Actionsströme des soeben ausgeschnittenen Herzens durch Knochen und Sehne zuzuleiten und den Muskel zum Zucken zu bringen, habe ich mehrere Male erfolglos wiederholt. Das rasch isolirte Herz wurde in einem Rahmen fixirt, im Innern mit einer bis zur Spitze des linken Ventrikels reichenden, außen mit einer nahe der Atrioventiculargrenze fest angelegten unpolarisirbaren Electrode versehen, während die stürmischen Pulsationen mit Hülfe von zwei Luftkapseln unter dem Muskelschreiber verzeichnet wurden. Der Mißerfolg von 4 so ausgeführten Versuchen war vermuthlich dem Umstande zuzuschreiben, daß trotz aller Eile die Pulsationen schon zu abnorm geworden waren in dem Augenblicke, wo die Ableitung beginnen konnte.

Um solchen Experimenten am isolirten Säugerherzen die Wege zu ebenen, wurde ein neues, von Professor *Kühne* schon mit Erfolg begonnenes Verfahren eingeschlagen, die Schlagfähigkeit länger zu erhalten. Wenn man während künstlicher Respiration alle Verbindungen des Herzens mit dem Thierleibe schließt und nur die mit der Lunge offen erhält, so kann man das Herz an der Trachea mit den Lungen aus der Brust nehmen, seinem Blute Sauerstoff nach Bedarf zuführen und die CO_2 nehmen, während dasselbe so lange in Bewegung bleibt und in sich selbst zurückkehrt, als die Herzschläge dauern. Die Ausführung war folgende: man leitete zuerst künstliche Respiration ein, öffnete den Thorax durch Spalten des Brustbeins, unterband der Reihe nach die Vena

¹⁾ Ich bewahre eine Zeichnung auf von 26 durch die ersten raschen Pulsationen in nicht ganz 5 Sec. hervorgebrachten secundären Gastrocnemiuszuckungen, von etwa 2 mm Hubhöhe (bei 5 gr. Belastung), zu deren Wiederholung durch Inductionsöffnungsschläge es unmittelbar darauf, unter genau gleich gebliebenen Bedingungen einer Annäherung der Inductionsrollen bedurfte, hinreichend um an der Zunge und selbst am gut befeuchteten Finger deutliche Empfindung zu erzeugen.

cava sup. sin., die Vena cava inf., die Art. aorta, endlich die Vena cava sup. dextr. und hob darauf das ganze Packet mit der Trachea aus dem Thorax. Das Präparat stellt eine Reduction des gesammten Blutkreislaufsapparats dar, in welcher der sog. Lungenkreis ungeschmälert erhalten, das System des Körperkreislaufes auf das der Coronargefäße reducirt ist. Das zwischen beiden Hälften bestehende Mißverhältniß kann für gewisse Zwecke gemildert werden durch Unterbindung von Zweigen der Lungenarterie, oder durch starke Reduction der Lungen, indem man diese stückweise abbindet. Für die vorliegende Aufgabe war davon Umgang zu nehmen, denn das Herz schlug vortrefflich weiter, falls die Blutfülle nur einigermaßen richtig getroffen, nicht zu groß und namentlich nicht zu klein war. Der Moment der letzten Venenunterbindung ist dafür entscheidend, aber es ist vorzuziehen, das Herz sich erst übermäßig füllen zu lassen und später aus einem Lungenarterienaste nach Bedürfniß Blut zu entziehen. Um das Thierstück am Leben zu erhalten wird die Respiration fortgesetzt, Verdunstung durch Schwimmenlassen auf $\frac{1}{2}$ procentiger NaCl-Lösung oder Einbringen in eine feuchte Kammer und die Abkühlung durch künstliches Erwärmen verhindert.

Wie lange und in welcher Weise das Herz fortzuschlagen vermöge, wird durch eingehende Untersuchungen noch festzustellen sein; ich habe es zur Erhaltung des Spieles am vortheilhaftesten gefunden, die Respiration nicht zu frequent und ergiebig zu machen, dieselbe von Zeit zu Zeit, 5—10 Min. zu unterbrechen und das Präparat inzwischen aus dem warmen Salzwasser, dessen Temperatur im Mittel 37° C. betrug und von 35 — 40° C. schwankte, herauszunehmen. Je nach der Vollkommenheit der vorangegangenen Lüftung schlug das Herz weiter, entweder weil der in's Blut gelangte Sauerstoff nur langsam verbraucht wurde, oder weil noch von dem Vorrathe in der Lunge gezehrt wurde.

Man empfängt daneben den Eindruck, als ob die große pleurale Oberfläche der Lunge den Gaswechsel ohne Aufblasen geraume Zeit zu unterhalten vermöchte. Unter noch nicht aufgeklärten Umständen mißlang das Experiment zuweilen derart, daß das Herz nach 7—10 Min. stillstand; in der Regel schlug es kräftig und frequent, 100—150 mal pro Minute, je nach der Temperatur während einer guten Stunde, worauf der Versuch abgebrochen wurde. Wurden die Pulsationen schwächer, so genügte kurze Abkühlung die Schlagfolge zu mäßigen und die Contraktionen zu kräftigen, worauf erneutes Erwärmen wieder zahlreiche und mächtige Schläge hervorrief. Durch Aussetzen der Athmung erlosch erst die Thätigkeit der Ventrikel, während die der Vorhöfe noch sehr frequent blieb; in diesem Stadium kehrte mit der Athmung die frühere energische Thätigkeit der Ventrikel zurück. Mehrere Male gelang es, den Vorgang 2 Stunden und länger zu erhalten.

An den fortschlagenden Kaninchenherzen waren sämtliche Versuche über secundäre Zuckung vorzüglich und mit aller Muße auszuführen und wenn auch curarisirte Gastrocnemien versagten, so zeigten doch die *M. sartorii*, deren Endstrecken in richtiger Weise mit der Spitze und Basis des Herzens in leitende Verbindung gesetzt waren, während langer Zeit einen Theil der Herzschläge durch secundäre Zuckungen an, welche mittelst einer auf das andere Ende des Muskelbändchens gelegten *N. ischiadicus* an einem Froschschenkel durch tertiäre Zuckungen weiter sichtbar gemacht werden konnten.



Ueber einige Muskelanomalien.

Von R. J. Anderson.

1. Vorkommen eines Musculus tibio-tarsalis sive tensor fasciae plantaris.

An der linken Unterextremität einer männlichen Leiche entpringt ein Muskel an dem unteren Ende der Linea poplitea und dem hinteren Rande der Tibia, wo er bis zur unteren Grenze des mittleren Drittels reicht. Sein Ursprung ist sehnig, die Sehnenfasern setzen sich auf die vordere Fläche des Muskelbauches fort. Letztere ist 12 Cm. lang, 2 Cm. breit. Die Muskelfasern setzen sich am unteren Ende der Tibia fort in eine platt cylindrische schmale Sehne, welche an die mediale Fläche des Fersenbeins zwischen dem M. abductor hallucis und dem M. plantaris und an das Ligamentum laciniatum sich ansetzt. Einige Fasern setzen sich in die Fascia plantaris fort, aus diesen entstehen die Mm. abductor hallucis und flexor digitorum brevis. Der Musculus plantaris ist ebenfalls vorhanden und entsteht vom Ligamentum posterius des Kniegelenks neben dem medialen Kopf des Musc. gastrocnemius. Er befestigt sich an der hinteren Fläche des Fersenbeins unter der Insertionsstelle des Musculus gastrocnemius. Am rechten Unterschenkel waren die Muskeln vor der Untersuchung entfernt worden. An beiden Seiten war das Sprungbein und das Kahnbein verschmolzen. — Cruveilhier¹⁾ hat einen Musc. soleus accessorius, welcher unter dem M. soleus entstand, beschrieben, Reinhardt²⁾ einen Musc. hallucis longus superior, welcher an der Linea poplitea entsprang, unter dem Ligamentum laciniatum durchging und sich an einen Theil der Fascia plantari ansetzte, woraus der Musculus accessorius hallucis longus inferior (Caro quadrata Sylvii) entstand. Macalister³⁾ betrachtet den Musculus tensor fasciae plantaris als eine Varietät dieses Muskels.

¹⁾ Traité d'anatomie descriptive. Myologie.

²⁾ Müller's Archiv. 1846. S. 298.

³⁾ A descriptive catalogue of muscular anomalies. Transactions of the Royal Irish Academy. 1872.

2. Ueber einige Varietäten des *M. subclavius*.

Der *Musc. subclavius* kann an seiner Insertionsstelle einfach oder doppelt vorhanden sein. Ich will nur einige Varietäten seines einfachen Vorkommens erwähnen. Cloquet¹⁾ sagt, dass dieser Muskel zuweilen an dem *Processus coracoides* sich ansetzt. Unter 88 während des Wintersemesters 1879—1880 präparirten Leichen fand ich dieses Verhalten nur in 4 Fällen. In diesen entsprang der *Musc. subclavius* an seiner gewöhnlichen Ursprungsstelle und befestigte sich am Schlüsselbein und dem *Ligamentum conoides*, auch am *Processus coracoides*.

An der linken Seite einer männlichen Leiche entspringt der *Musc. subclavius* von der oberen Fläche der ersten Rippe am lateralen Ende des Knorpels neben dem angrenzenden Theil des Knochens und vom oberen Rande der zweiten Rippe. Beide Köpfe sind sehnig und dazwischen geht die *Arteria perforans* der *Art. mammaria interna* durch. Die Insertionsstelle ist wie gewöhnlich. Bedeckt vom *Musc. pectoralis major*, grenzt der *M. subclavius* an den *Musc. intercostalis externus* und liegt über seinem vorderen Rande. Die Fasern des *M. subclavius* sind parallel denen des *Musc. intercostalis externus*.

¹⁾ Manuel d'anatomie descriptive. Translated by Knox.

